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Editor's Note

The Columbian Quincentenary, observed a year ago, awakened the public's interest in maritime history and provoked considerable controversy. The observation of the 501st year is more reflective, a product of the light generated with less heat. *The American Neptune*'s contribution to the study of Columbus is in the following collection of essays, which are the product of the nineteenth meeting of the New England Medieval Association held at the Peabody Essex Museum in October 1992. The theme of the conference was "Columbus and the Medieval Maritime Tradition: European and Islamic Perspectives." The essays printed here are revised versions of several of those papers, edited to fit into the limited space of this expanded issue.

The objective of the conference was to provide a retrospective look at the maritime world of Columbus which incorporated the Islamic perspective. The program organizers included myself and Paul Chevedden of Salem State College, an accomplished scholar of medieval Islam who contributed substantially to all elements of the conference. Donald Marshall and the staff of the Peabody Essex Museum thoughtfully took care of local arrangements at the museum, and we owe our thanks to Peter Fetchko in his capacity as museum director for supporting our efforts. New England Medieval Association president Alfred Andrea of the University of Vermont and his officers and councillors were very cooperative, especially the secretary, Fred Cazel of the University of Connecticut.

We hope that the readers will find in these essays further understanding of the complex world of Christopher Columbus. The focus is maritime with an interdisciplinary perspective. The ships in the age of Columbus are examined against a backdrop of replicas which have sailed waterways from the Atlantic to the Scioto River in Columbus, Ohio in the past year. The mentalité of Columbus and his age are examined from textual studies to find the reasons why. Study of the geographical knowledge of Muslim scholars suggests that Columbus grasped more about the nature of the earth than is generally understood. Indeed, he may have left his own vision of the world within the map of Ottoman geographer Piri Reis.

The lead article in volume one, number one of the *Neptune*, published in 1941, was a study of Christopher Columbus by one of the journal's founders, Samuel Eliot Morison of Harvard University. It is appropriate that we acknowledge him on this occasion. We also recognize a later *Neptune* editor and maritime historian, Archibald R. Lewis, and his wife Elizabeth, to whom the conference was dedicated.

The recent meeting of the National Maritime Alliance in Boston was a successful effort to bring together those committed to maritime history and preservation. The most dramatic result was the decision of the Alliance to accept the role as coordinating agency for maritime heritage preservation in America. The Alliance will assume many of the duties formerly performed by the Maritime Office of the National Trust for Historic Preservation.

Representative Tom Andrews of Maine introduced to Congress on 15 September the National Maritime Heritage Act. The Act calls for $5 million to be set aside annually for the preservation of America's maritime heritage. The funding would come from income produced by scrapping the U.S. reserve fleet. The commitment would be for seven years, yielding $35 million. The monies generated would go to the Department of the Interior which would use the National Maritime Alliance as the administrative agency to distribute funds. Grant proposals will be encouraged and awards distributed on a competitive basis.

The successful passage of the Act would greatly enhance maritime preservation efforts. Readers are encouraged to write their local representatives and senators as well as Representative Tom Andrews and Merchant Marine and Fisheries Committee Chair Representative Gerry Studds, at the U.S. House of Representatives, Washington D.C. 20515, with a copy of your letter to the National Maritime Alliance, 229 Washington St., Bath, ME 04530.

The encouraging aspect of the National Maritime Alliance meeting on Thompson Island in Boston Harbor was the variety of maritime interests represented by those in attendance. From established museums to start-up preservation projects, the assembly included registrants from America's coasts and waterways. This is an encouraging sign of the continued revival of matters maritime. The dedication of those in the field is quite extraordinary. We call upon all of those devoted to the cause of maritime history and preservation to support this initiative.

TIMOTHY J. RUNYAN

Cleveland, Ohio

The Evolution of Spanish Ship Design From the Fifteenth to the Eighteenth Century

CARLA RAHN PHILLIPS

The evolution of European ship design arguably experienced its most dynamic period in the fifteenth century. Shipbuilding conventions in Columbus's time, which had benefitted from earlier changes to oceangoing vessels, were modified and adapted thereafter in order to address the challenges posed by global voyaging. In other words, Columbus's ships occupied one moment in a very long development that spanned the whole age of sail. Scholars know very little about the ships Columbus sailed, however, despite a lively interest over the centuries in the early European voyages of exploration. For that matter, very little is known about any European ships before the late sixteenth century. Sketches and paintings are rare, plans are virtually nonexistent, and the evidence from nautical archeology has just begun to be discovered and analyzed. For the moment, the best sources available to scholars are documents describing various real and ideal ships and pictorial evidence of varying plausibility. In the case of Spain, however, the documentary evidence is mounting steadily as scholars discover the astounding wealth and variety of information about ships in the archives in Seville, Simancas, Madrid, and port cities around the Iberian peninsula.

Historians have attempted to use this sparse evidence to arrive at estimates for the dimensions of Columbus's ships and others in the early decades of European global exploration. For example, Carlos Etayo Elizondo and José María Martínez-Hidalgo Terán each revised the estimates of scholars from the late nineteenth century onward.[1] Most scholars working in this field think that Etayo's estimates are too small, for a variety of reasons, and have generally preferred Martínez-Hidalgo's figures, which served as the basis for the replicas of Columbus's three ships constructed by the Spanish government for the 1992 Quincentenary. Martínez-Hidalgo's estimates for the *Santa María* were based on the fact that the ship was a *nao*, a typical merchant vessel of the late fifteenth century. Martínez-Hidalgo proposed configurations for the *Santa María* that supposedly measure about 105 *toneladas*, in agreement with the comment in a 1575 treatise that the largest of Columbus's ships was "very little larger than 100 *toneladas*."[2] Martínez-Hidalgo had in mind what he called "light displacement tons," a concept quite alien to the fifteenth and sixteenth centuries. By the formula for calculating tonnage in the early sixteenth century, however, Martínez-Hidalgo's figures for the *Santa María* yield a total of 250 *toneladas*, and the replica based on his figures measures 239 *toneladas*, both unacceptably large.[3]

Martínez-Hidalgo's configurations for the *Pinta* and the *Niña* were based on proportions for caravels in the Portuguese *Livro nautico*.[4] That is certainly plausible, and the tonnages he gives are plausible as well — about sixty-one *toneladas* for the *Pinta* and fifty-three for the *Niña*. Because he had in mind "light displacement tons," however, his measurements yield far larger tonnages when used in the formula for sixteenth-century Spanish ships. This author has argued that Martínez-Hidalgo's estimates for all three of Columbus's ships were too large,[5] and many other scholars agree, including the late John Patrick Sarsfield.[6] Before his untimely death,

1. Carlos Etayo Elizondo, *La expedición de la "Niña II"* (Barcelona: Plaza y Janes, 1963), and the same author's *Naos y carabelas de los descubrimientos y las naves de Colón* (Pamplona, 1971). José María Martínez-Hidalgo Terán, *Columbus's Ships*, ed. and trans. Howard I. Chapelle (Barre, MA: Barre Publishing Co., 1966). Etayo presents an extensive analysis and critique of earlier estimates in *Naos*, 217-41.

2. The treatise in question was Juan Escalante de Mendoza, *Itinerario de navegación de los mares y tierras occidentales* (Madrid, 1575) in *Disquisiciones náuticas*, ed. Cesáreo Fernández Duro, 6 vols. (Madrid: Sucesores de Rivadeneyra, 1876-81), 5:445.

3. An excellent analysis of official tonnage formulas is provided by José Luis Rubio Serrano, "Métodos de arqueo en el siglo XVI," *Revista de Historia Naval* 6, no. 24 (1989): 29-70.

4. Martínez-Hidalgo, *Columbus's Ships*, 96-100. *Livro nautico* is a common variant for the name of Fernando de Oliveira's *Livro da fabrica das naus* (ca. 1565), edited by Henrique Lopes de Mendonça, as *O padre Fernando Oliveira e a sua obra nautica* (Lisbon: Academia Real das Sciencias, 1898).

5. Carla Rahn Phillips, "Size and Configurations of Spanish Ships in the Age of Discovery," *Proceedings of the First San Salvador Conference*, 30 October - 3 November 1986, comp. Donald T. Gerace (Ft. Lauderdale, FL: CCFL Bahamian Field Station, 1987.)

6. Private correspondence to author, 23 November 1987.

Sarsfield commissioned the construction of a replica of an early Iberian caravel in Brazil, where traditional shipbuilding methods still survive. The replica not only sails well but is widely thought to be the best approximation of early caravels yet devised.[7] For the sake of argument, I postulated that the *Santa María* was about 108 *toneladas*, the *Pinta* 75, and the *Niña* 55, based on what little we know about the ships and their crews.[8]

Until more evidence is generated by nautical archaeology, the best hope for arriving at plausible estimates of Columbus's ships and others of that epoch lies in the use of contemporary methods for measuring ship tonnages and in the study of contemporary ship configurations. A plausible configuration for the *Santa María* is the simple "as, dos, tres," the proportion common to merchant *naos* of the time, with the keel twice the beam, and the length three times the beam. The depth in the hold, from the lowest planked deck to the floor, was about half the beam.[9] Caravels were somewhat slimmer and shallower than *naos*, but by how much is not clear. However, configurations specified for Portuguese caravels and for Spanish corsairing frigates and dispatch boats provide a range of possibilities. By using estimated tonnages and configurations for Columbus's ships and a sixteenth-century formula for calculating ships' tonnages, one can derive a set of likely dimensions for each ship.[10] The results are summarized in Table 1, along with comparative figures from Etayo and the 1992 replicas based on Martínez-Hidalgo's estimates. My method has the merit of estimating ships' dimensions that conform to tonnage formulas understood by contemporaries, to proportions of ships common at the time, and to the few mentions of Columbus's ships that have been found in documents of the time. The entire matter of Columbus's ships is highly speculative, of course, and is likely to remain so.

In their design, Spanish ships of the late fifteenth century benefitted from a blending of characteristics from northern and southern Europe and from the Islamic world as well. In general, the full-rigged ship of the fifteenth century, represented by the *Santa María*, had three masts, the foremast and mainmast with square sails and the mizzenmast with a lateen sail. It was steered with a sternpost rudder. Such ships were commonly called carracks or *naos*. In contemporary artwork they were usually depicted with a large rounded hull, a high, protruding forecastle, a smaller aft-castle, and a deeply cut waist in between. Neither the styles of sailing ships nor their configurations, however, followed rigid definitions in the fifteenth century. From its basic design, the full-rigged ship developed along several paths, each one aiming toward the solution to a particular set of needs and circumstances among European seafarers. In Spain, one of those developmental paths led to later versions of the *nao* and to the galleon, two of the dominant ship types in Spain's Atlantic trade. By following the galleon, and to a lesser extent the *nao*, one can trace the main outlines of the evolution of Spanish ship design.

Neither the origin of the galleon as a sailing ship nor its evolution is clear. The name would seem to derive from the medieval oared galleys used in Mediterranean warfare, and vessels called "galeones" were used as early as the thirteenth century on the southern and eastern coasts of the Iberian Peninsula.[11] Venice used oared *galleoni* for river patrols in the fifteenth century, and Spanish *galeones* participated in fishing fleets off the Cantabrian coast in 1513.[12] Both Italy and Spain employed full-rigged varieties of galleons before 1530; several *galeones* appeared on a list of ships sailing for the Spanish crown in 1526, with no indication that they were new or unusual vessels. They were presumably employed in a military capacity, although it is not clear what they looked like.[13] The famous 1529 "Carta Universal" of Diego Ribero, cosmographer to the king of Spain, depicted several ships that appear to be full-rigged caravels or galleons.[14] The caravel in its most characteristic form was a small, agile ship with one deck and two lateen sails, although Spanish caravels often carried a full rig, and some caravels might carry four masts with various combinations of square and lateen sails. The forecastles of the

7. Roger C. Smith, "Replicating the Ships of Columbus," *Archaeology* 45 (May-June 1992), 41. See also Jerry Goodale, "Voyage of the Sarsfield *Niña*," *Archaeology* 45 (May-June 1992), 42-43.

8. The late Alice Bache Gould painstakingly researched the lives of every man on Columbus's first voyage and was able to identify eighty-seven of them, with ninety as a usable estimate for the total: forty on the *Santa María*, twenty-six on the *Pinta*, and twenty-four on the *Niña*. Alicia B. Gould, *Nueva lista documentada de los tripulantes de Colón en 1492* (Madrid: Real Academia de la Historia, 1984), 53-56. This welcome volume compiles articles published by Gould between 1924 and 1944. She died in 1953.

9. Martínez-Hidalgo estimated the *Santa María*'s length at 2.98 times the beam, and depth .49 times the beam. *Columbus's Ships*, 96-100.

10. Phillips, "Sizes and Configurations," 78-80.

11. José Luis Casado Soto, *Los barcos españoles del siglo XVI y la Gran Armada de 1588* (Madrid: Editorial San Martín, 1988), 187, citing R. Eberenz, *Schiffe an den Küsten der Pyrenäenhalbinsel* (Frankfort, 1975), 183-189.

12. José Luis Casado Soto, "Pescadores y linajes. Estratificación social y conflictos en la villa de Santander (siglos XV y XVI)," *Altamira* 40 (1976-1977): 185-219.

13. Archivo General de Simancas (Simancas, Valladolid), hereafter AGS, CMC 1a, leg. 436.

14. Diego Ribero, "Carta Universal," in the Biblioteca Apostolica Vaticana.

ships on Ribero's 1529 map were much lower than the aft-castles, a characteristic feature of both caravels and galleons that contrasted with the high castles both fore and aft on carracks and some other merchant vessels. Ribero's ships also display a "square tuck" or flat stern, a feature designed for speed that was characteristic of both caravels and galleons.

The speed and maneuverability of the galley as a war machine inspired several Spanish attempts to develop large sailing ships that could also be oar-propelled. From 1540 the Spanish nobleman and mariner Don Alvaro de Bazán experimented with a combined use of oars and sails, producing "galleons of new invention," designed to be true heirs to medieval war galleys. In his proposals to the crown, Bazán called his vessels *armada* (literally "armed") ships rather than merchant vessels, and provided them with heavily reinforced and braced hulls, improved placement of the artillery, better topmast yards, a shallower draft, and oars as well as sails. The oars proved useless and were abandoned in later designs, but his other innovations were adopted to good effect by Spanish galleons.[15] Extrapolating from prior experience, Pedro Menéndez de Avilés, a Spanish official in Florida, built eight small galleons or "galizabras" in Vizcaya in 1568, with keel to beam ratios of about 2.5 and length to beam ratios of nearly 3.7. Because of this, Menéndez is often credited with lengthening sailing vessels for the Atlantic.[16] Nonetheless, the ships he built were quite small — about 200 *toneladas* — and cannot be considered equivalent to the larger galleons that were the work-horses of Spain's Atlantic fleets. Moreover, the "galizabras" handled badly, and Menendez's experiment must be qualified as an interesting failure rather than a success. Later warships would succeed in combining greater length with stability and carrying capacity, but only after decades of trial and error.

Long before 1570 the Spanish unquestionably had ample experience with building what they called galleons, although the ships are difficult to distinguish from *naos* in documents of the time either in designation or function. The same ship might be called a galleon and a *nao* in the same document and might have served at different times as a warship, a merchant ship, or a whaler. Some galleons as large as 700 *toneladas* were registered in the province of Guipuzcoa in the 1570s, although the average would probably have been about 350 *toneladas*. Other galleons could be smaller and carry less crew and artillery than merchant ships, and both *naos* and galleons tended to grow larger in the later sixteenth century, encouraged and subsidized by King Philip II.

By the late sixteenth century the Spanish galleon had acquired its classic shape, with a high aft castle, usually consisting of a half-deck, a quarter-deck, and a poop deck; a flat stern, at the top of which was painted the ship's namesake; a low, set-back forecastle; a beak below the bowsprit; and full rigging, complete with topsails on the fore and main masts. It was faster, more maneuverable, and better able to sail into the wind than earlier galleons, but it was not a dedicated warship. A certain amount of speed and agility had to be sacrificed for carrying capacity in the hold, to meet the Spanish empire's need for multi-purpose vessels.

Craftsmen's traditions continued to govern ship construction in the sixteenth century, but gradually officials felt the need for a more rigorous approach. The few manuscripts on ship design that have come to light for the sixteenth century show striking similarities, whether they come from Venice, Portugal, Spain, or England.[17] Spurred by the demands of Spain's Indies trade, Diego García de Palacio published the first full-blown treatment of ship construction and design. His *Instrucción náuthica*, printed in Mexico City in 1587, gave detailed mathematical proportions for the hull and the rigging and discussed ship construction, sailmaking, ships' officers and crew, and various other topics as well. (See table 2 on page 237.) García and his counterparts elsewhere were much concerned with the ideal dimensions and proportions for oceangoing ships, blending theory with practical experience of the sea and moving ship design a bit farther down the long road that would make shipbuilding more a science than an art.

The best documentary evidence available for studying the range of ships that represented galleons

15. Francisco-Felipe Olesa Muñido, "Marina oceánica de los Austrias," in *El buque en la armada española* (Madrid: Silex, 1981), 120-122; Casado Soto, *Barcos españoles*, 139-41.

16. Clarence Henry Haring, *Trade and Navigation between Spain and the Indies in the Time of the Hapsburgs* (Cambridge, MA: Harvard University Press, 1918), 264-265. A memorandum giving the measurements of the ships and dated 17 December 1575 appears in Archivo General de Indias (hereafter AGI), Patronato, leg. 260, no. 2, ramo 34.

17. F. C. Lane analyzes the text of Pre Theodoro de Nicolò in "Venetian Naval Architecture about 1550," *Mariner's Mirror* 20 (1934). The Portuguese Fernando de Oliveira's detailed nautical treatise *Livro da fabrica das naus* (ca. 1565) can be found in Henrique Lopes de Mendonça, *O padre Fernando Oliveira e a sua obra nautica* (Lisbon, 1898). The Spanish treatise of Juan Escalante de Mendoza, *Itinerario de navegación de los mares y tierras occidentales* was written in 1575 and can be found in *Disquisiciones náuticas*, ed. Cesáreo Femández Duro, 6 vols. (Madrid: Sucesores de Rivadeneyra, 1876-81), 5: 413-515. The English manuscript "Fragments of Ancient English Shipwrightry," attributed to Matthew Baker and generally thought to date ca. 1586 (Pepys Collection, Magdalene College, Cambridge University), is noteworthy for its beautiful drawings, although the rigging plans are thought to have been added later to the hull designs.

relates to the "Great Armada" sent by Spain to invade England in 1588 and the English fleet gathered to defend against it. The most careful analyses of those fleets list 130 ships on the Spanish side and 197 ships on the English side.[18] The Spanish fleet included not only galleons and *naos* built in Spain, mostly on the Cantabrian coast, but also ships that the Spanish called galleons, built in Portugal, France, and the Mediterranean. Galleons accounted for 15 percent of the Spanish fleet, about equally divided between Spanish and Portuguese galleons, plus a very few from other countries. The rest of the fleet included *naos* armed for battle, cargo hulks, and small support and dispatch vessels of several kinds. The majority of ships in the fleet, many of foreign origin, was embargoed by the crown and rented for the duration of the campaign. Virtually all of the 130 ships in the Spanish fleet were measured officially before the Great Armada set sail, including twenty designated as galleons and twenty-nine designated as *naos*. Each ship was listed by beam, depth in the hold, and length, the three dimensions used by the Spanish to calculate tonnage.

Based on the measurements of ships in the Spanish fleet in 1588, the galleons from Portugal had a ratio of length to beam of 3.35, and a ratio of depth to beam of 0.53. In other words, they were about three and one-third times longer than they were wide, and just over half as deep in the hold as they were wide. The large galleons made on the Cantabrian coast of Castile were slightly longer and deeper, with ratios of 3.5 length to beam, and 0.65 depth to beam. The smaller Castilian galleons had ratios of 3.6 and 0.63, making them longer and shallower than their larger equivalents, but deeper in the hold than their Portuguese counterparts. The one French galleon had ratios of 3.75 and 0.58, and the one galleon from Florence had ratios of 3.85 and 0.62. Without exception in the Armada campaign, the *naos* were considerably wider and deeper in the hold than any of the galleons. The twenty-one Cantabrian *naos* had an average length-to-beam ratio of 3.07, and a depth to beam ratio of 0.67. Eight *naos* built in various places in the Mediterranean had ratios of 2.87 and 0.6; in other words, they were wider and shallower than the Cantabrian *naos*.[19]

Overall, the English ships in the Armada campaign seem to have been somewhat longer and shallower in the hold than Spanish ships of roughly the same tonnage, although measurements exist for very few of the English ships. As long as the English were able to use their cannon to good effect, and avoid being grappled and boarded, the greater defensibility of the Spanish galleons did them little good.[20] The English won a great victory in 1588, preventing the invasion of their homeland and inflicting considerable damage on the Spanish fleet. Yet that damage has often been overstated. Based on official documents recently analyzed in detail, the Spanish fleet lost 34-35 vessels of their total of 130, mostly on the homeward journey after the battle. The heaviest losses occurred to ships designed for trade in the Mediterranean, the North Sea, or the Baltic. Few Spanish-built ships were lost — only 20 percent of their overall tonnage — and no Spanish galleons or their auxiliary craft.[21] Even in defeat, Spain's galleons proved seaworthy and defensible.

All over Europe in the early seventeenth century, naval powers consolidated and assimilated the rapid changes made during the sixteenth century, looking for the ideal combination of beam, keel, length, and depth that would provide ships with the characteristics they needed. The most successful alterations in the proportions of warships were introduced cautiously, with attention to experience. Whereas England stayed with a basic hull design for warships that was long in relation to its beam, design changes in Spain sought to retain a large cargo capacity as well as sufficient speed and agility for military purposes. This evolution is difficult to trace in detail for all of Europe's maritime powers, in part because of a lack of records, but the case of Spain is well documented. As John Fincham noted in his pioneering study of naval architecture in 1851:

> . . . as the science of naval architecture was formerly encouraged more in Spain than elsewhere, the ships of that country were before those of the more northern nations of Europe, in possessing the excellence of form from which both fast sailing and other good qualities result. This superiority was exhibited in some of the Spanish ships which were captured at the battle of Trafalgar."[22]

18. See, for example, Colin Martin and Geoffrey Parker, *The Spanish Armada* (London: Hamilton, 1988).

19. Casado Soto, *Barcos españoles*, 186-199. The names and measurements of each ship appear in tables on pp. 209-221.

20. Martin and Parker, *Spanish Armada*, provide a thorough analysis of the preferred English tactic of "prolonged broadside firing at close range" (p. 52). Their analysis of the relative merits of Spanish versus English guns has been strongly challenged by José Luis Casado Soto, "Atlantic Shipping in Sixteenth-Century Spain and the 1588 Armada," in M. J. Rodríguez-Salgado and Simon Adams, eds., *England, Spain and the Gran Armada 1585-1604. Essays from the Anglo-Spanish Conferences London and Madrid 1988* (Savage, MD: Barnes & Noble Books, 1991), 122-24.

21. Casado Soto, "Atlantic Shipping," 122.

22. John Fincham, *A History of Naval Architecture: To Which is Prefixed, An Introductory Dissertation on the Application of Mathematical Science to the Art of Naval Construction* (London: Whittaker and Company, 1851), 47.

After Spain made peace with its various adversaries between 1598 and 1609, the crown's total tonnage afloat declined,[23] but a permanent navy remained. Even in peacetime, squadrons of galleons were needed to protect merchant fleets on the transatlantic run. During the reign of Philip III (1598-1621), the Spanish monarchy exercised closer control over the shipbuilding industry to bring private construction in line with public needs. Following long tradition, the crown sought to ensure that merchant shipping could be adapted for military duty in the event that hostilities resumed. Not only were the sizes and configurations of ships regulated, but the crown specified where ships were to be built and where materials and labor should be procured. By regulating ship construction, the crown maintained a reserve of vessels suitable for military use at the expense of private shipowners. To encourage cooperation, the crown consulted those shipowners in shaping the regulations. Three major sets of shipbuilding ordinances appeared during the reign of Philip III — in 1607, 1613, and 1618 — accompanied by lively government-sponsored public debate.[24] Royal policy showed a willingness to experiment not only with methods for the procurement of ships, but also with their size and configuration, searching for the ideal compromise between merchant vessels and warships.

An ordinance of 21 December 1607 specified for the first time the dimensions for ships to be used in the translatlantic trade. The rules proposed a keel-to-beam ratio averaging 2.6 to 1, and a length-to-beam ratio of 3.5 — much narrower than traditional sailing ships — and a maximum size of 567 *toneladas* — much smaller than some merchant ships in the late sixteenth century. Although the rules were not to take effect until March of 1609, merchant shipbuilders complained that they mandated ships far more suitable for warfare than for trade, incorporating less cargo space than traditional designs. Several shipbuilders even criticized their value as warships. They argued that the new ships would be so long, with so little depth in the hold, that they might roll too much on the open sea, especially during storms; even a small surge could flood the lower gunports on ships with so little depth. The critics also noted that experience had proven the military value of ships that sat high in the water, because their fighting men were at an advantage in both boarding and firing guns at an enemy. They conveniently ignored the fact that Spanish gunnery in the Great Armada campaign of 1588 had been ineffective in firing at low-built English ships, but old wisdom died hard.

Before the rules went into effect, the Spanish crown answered its critics by naming a panel of "persons practiced in navigation and the fabrication of ocean-going ships, to try to emend some defects that experience has found in the General Ordinances of 1607 on the making of ships of war and of commerce." The search for acceptable multi-purpose vessels engaged mariners, shipbuilders, merchants, and theoreticians in a common enterprise lasting several years.[25] One of the many participants, the experienced mariner and shipbuilder Juan de Veas, suggested an alternative both to traditional measures and to the 1607 rules, advocating ships similar to Dutch designs, shallower-draught and more flat-bottomed than usual. Veas's proposed design aimed to combine speed with ample cargo space, a seemingly ideal combination, yet it too had problems. Tomé Cano, another experienced participant on the royal commission, pointed out that such ships were hard to handle and had a tendency to pitch and toss even in light seas.[26] As debate proceeded, the crown continued to subsidize large private ships suitable for warfare, providing incentives for merchants to fall into line with government regulations.

A new set of rules in 1613 proposed a ratio of length-to-beam that was still higher than traditional ships, but lower than the 1607 rules, averaging between 3.2 for galleons of about 1,100 *toneladas* and 3.6 for galleons of about 380 *toneladas*. The depth in the hold, often three-quarters the beam in merchant ships, was set at half the beam, because the lengthened keel would presumably allow for more cargo with less depth. In addition, the aft-castle was to be lowered for greater stability, and outboard platforms (often used to increase cargo space) were banned altogether. Merchants still complained that the vessels defined by the 1613 rules were shaped like warships, although they would also have to be used for trade.[27]

23. I.A.A. Thompson, *War and Government in Habsburg Spain* (London: Athlone Press, 1976), 195-197.

24. For a fuller discussion of this process, see Carla Rahn Phillips, *Six Galleons for the King of Spain: Imperial Defense in the Early Seventeenth Century* (Baltimore: Johns Hopkins University Press, 1986), 29-32.

25. For the 1607 rules and documents from the subsequent debate, see Fernández Duro, *Disquisiciones náuticas*, 5: 50-55, 376-78; Martín Fernández de Navarrete, comp., *Colección de documentos y manuscriptos compilados*, ed. Julio Guillén Tato, 32 vols. (Nendeln, Lichtenstein: Kraus-Thompson Organization Limited, 1971), 23 (1), doc. 45, pp. 559-63 and 24 (2), doc. 49.

26. Tomé Cano, *Arte para fabricar y aparejar naos* (Madrid, 1611), ed. Enrique Marco Dorta (Laguna, Canary Islands: Instituto de Estudios Canarios, 1964). Although Cano published in 1611, the book was substantially complete in 1608.

27. Gervasio de Artiñano y de Galdácano, *La arquitectura naval española (en madera)* (Madrid, 1920), 128-129; Navarrete, *Colección de documentos*, 24 (1), doc. 15, pp. 133-42; Olesa Muñido, "La marina oceánica," 140.

The guild of merchants and shipbuilders in Seville tried to stall instatement of the 1613 regulations, arguing that ships' carpenters feared no one would buy their ships if they followed the mandated proportions. Self-interest undoubtedly motivated both merchants and shipbuilders, because the new rules diminished cargo space in the interests of producing more speed and maneuverability. Nonetheless, the crown had to compromise as well, and exempted existing ships from the new rules. Surprisingly, given the vehemence of merchant opposition, when royal officials surveyed all the ships in Seville and Cádiz in February of 1614, they found thirty-three of the seventy-six ships surveyed to conform substantially to the new rules, and another twenty that could be remodeled easily. They found only twenty-three that they thought should be retired after one more voyage, either because of their condition or their unsatisfactory proportions.[28]

On 16 June 1618 the Spanish crown published a new set of ordinances for ship construction, mandating longer, shallower vessels with less superstructure, designed to make them faster, easier to handle, and more agile. Nevertheless, they were still supposed to be good cargo carriers, and to that end the crown made noteworthy concessions to the commercial community.[29] Although the rules by no means gained universal approval, merchants accepted them as the best compromise they were likely to get. Besides stating detailed mathematical proportions for ships on Atlantic voyages, the new ordinances specified a length-to-beam ratio of about 3.1 for ships of 1,000-1,100 *toneladas*, and about 3.4 for medium sized ships of 300-400 *toneladas*. Depth in the hold was to be about half the beam in ships of all sizes. The maximum size for merchant ships was set at 624 *toneladas*, small enough to pass the sandbars at Sanlúcar de Barrameda, downriver from Seville, and at San Juan de Ulúa on the Mexican coast. Increased space in the new design supposedly reduced the need to stow cargo in the superstructures. Even galleons built for the Indies run had to follow the 1618 rules, which made them wider than Spanish galleons of comparable size in the Great Armada of 1588, and therefore more suitable for cargo.

With the publication of the 1618 ordinances, the major naval legislation of Philip III's reign was completed. As long as the peace treaties held, the king and his advisors continued a policy of promoting private shipbuilding rather than building up the royal navy. When warfare resumed in 1621, however, that strategy proved inadequate, and the crown began to contract for galleons from private shipbuilders, guided by the 1618 ordinances. Simultaneously, the Spanish government built more specialized warships, such as small frigates,[30] but the galleon remained a multipurpose vessel. During the reign of Philip IV (1621-65), the crown continued to build ships of its own, as well as forcing private shipbuilders to produce vessels suitable for embargo in wartime.

Throughout Europe during the late seventeenth century, there seems to have been a greater divergence in both size and configuration between merchant and military vessels. Merchant vessels continued to follow patterns that had proven optimal in the previous century. Military vessels emphasized characteristics more suited to combat than to carrying capacity, as experience showed builders how they could safely lengthen the hull for increased speed. Principal warships also became much larger. In Spain, some argued that the nature of trade in Spanish America, with many small ports over a broad expanse of pirate-infested waters, made medium-sized ships more desirable than large ones. Nonetheless, in Spain as well the trend was unmistakably upward.[31] A partial list of ships that sailed for the Spanish crown from 1600 to 1665 included detailed information for thirteen galleons and nine *naos*. The galleons measured an average of 753.5 *toneladas* and the *naos* an average of 651.3 *toneladas*.[32]

A new flurry of officially sponsored debate over Spanish ship design occurred in the late seventeenth century, centering around 1680. Memoranda exist from about a dozen men with decades of experience as shipwrights, naval commanders, merchants, or in a combination of those jobs. Each had strong ideas about the ideal configurations of ships for use on the Indies run, either as galleons that could also carry cargo or as *naos de guerra*, merchant vessels suitable for battle. The distinction was still not clear, and the same proportions were designed to apply to both types of vessel. Before dismissing the lack of purpose-built warships as a strategic error for Spain, however, one should remember two things. First, by compromising on ship design with the commercial community, the Spanish government effectively shifted much of the financial burden for building and maintaining a reserve navy into private

28. Navarrete, *Colección de documentos*, 24 (1), docs. 11-14, pp. 93-131.

29. An original version of the printed regulations can be found in Archivo General de Marina (Madrid, Museo Naval), hereafter AGM, C. F. 134.

30. Enrique Otero Lana, "Un avance en la construcción naval: Las fragatas construídas en La Habana hacia 1600," *Revista de Historia Naval*, no. 34 (1991): 87-94.

31. Fernando Serrano Mangas, *Galeones de la Carrera de Indias, 1650-1700* (Seville: Escuela de Estudios Hispano-Americanos de Sevilla, 1985), 16.

32. AGM, ms. 471, fols. 157-74.

hands. Second, the same design characteristics that made a vessel able to carry cargo also contributed to its ability to carry increased armament. As vessels were built larger, maintaining their stability while fully laden and under sail was of crucial importance, regardless of whether they were used for military or commercial purposes.

The well-known treatises on ship design by Antonio Garrote in 1691 and Antonio de Gaztañeta in 1720 displayed the same concerns as their immediate precursors — to maximize size while retaining as much stability, strength, speed, and carrying capacity as possible. The proportions proposed by Garrote differed little from those of lesser-known experts a decade or so earlier. Likewise, Gaztañeta's recommendations to the government evolved from a long line of naval treatises that stretched back into the sixteenth century. The recent discovery of a manuscript by Gaztañeta has energized the study of ship design in Spain, and a team of Spaniards is currently working on an edition of that manuscript. It will undoubtedly shed new light on our knowledge of ship design in the eighteenth century, but one doubts that anything very surprising will emerge from Gaztañeta's treatise. Changes in ship design proceeded slowly and incrementally, building upon proven past designs and moving cautiously to address changing needs. The measurements of real ships typically changed even more slowly than measurements in theoretical treatises. The stakes were too high to do otherwise.

In 1730 the Spanish government launched a warship called the *Princesa*, very large for its time at over 1,700 *toneladas*. It was captured by the English during a battle in 1740. According to a modern expert on the British navy: "The size of some of the large Spanish ships, such as the *Princesa*, considerably shocked the naval administration" in England.[33] As they increased the size of their own warships, the English meticulously copied the excellent lines and handling qualities of the *Princesa*.[34] She became, in effect, the prototype for the 74-gun ship, the reliable mainstay of England's eighteenth-century navy.

Thus, Spanish ship design changed from Columbus's time to the early eighteenth century by a process that involved government regulation, discussion, consultation, and debate, often theoretical but anchored in the knowledge of how real ships performed. The nature of the debate would change in the late eighteenth century, as scientific experiments in the physics of motion and resistance moved ship design farther away from traditional methods. Before then, however, the needs of the Spanish empire for versatile oceangoing vessels led the government to engage a wide range of experts in questions of ship design, especially merchants, mariners, shipwrights, and bureaucrats. Regardless of dynastic turnovers and changes in political priorities, that process seems to have remained constant. The result was a broadly based consensus on designs that worked — not far from the cutting edge of theoretical prescriptions, yet not so close as to risk disaster. Overall and over time, Spanish ships seem to have been remarkably successful at fulfilling their defined functions, and that, above all else, is the ultimate test of ship design.

33. Brian Lavery, *The Arming and Fitting of English Ships of War, 1600-1815* (Annapolis, MD: Naval Institute Press, 1987), 119.

34. Fincham, *History of Naval Architecture*, 82.

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Table 1

Estimated Configurations of Columbus's Ships in Rounded Off Meters, Feet, and *Codos*

Ship	Source*	*eslora* (length)			*quilla* (keel)			*manga* (beam)			*puntal* (depth)		
		mt	ft	co	mt	ft	co	mt	ft	co	mt	ft	c
Santa María	Replica	27	86	47	16	52	29	8	26	14	3	11	6
	Phillips	18	58	32	12	38	21	6	19	11	3	10	5
	Etayo	14	46	25	10	33	18	6	19	10	4	14	8
Pinta	Replica	23	74	40	16	52	29	7	21	12	2	7	4
	Phillips	17	55	30	13	42	23	5	18	10	2	7	4
	Etayo	13	41	22	10	31	17	4	13	7	2	7	4
Niña	Replica	21	70	38	16	51	28	6	20	11	2	7	4
	Phillips	15	50	27	12	39	21	5	16	9	2	7	4
	Etayo	12	38	21	8	28	15	3	11	6	2	6	4

mts. = meters of 39 inches each
ft. = feet of 12 inches each
Codos = the codo real of 22 inches each, used for shipbuilding

Estimated Tonnages of Columbus's Ships

Ship	Source*	Displacement in Light Conditions	Maximum Displacement	Calculated *toneladas* by 16th Century Formula**
S. María	Replica	105	224	239
	Phillips			108
	Etayo			122
Pinta	Replica	52	116	116
	Phillips			75
	Etayo			40
Niña	Replica	49	100	94
	Phillips			55
	Etayo			27

*Sources:

Replica: Official measurements of the replicas built by the Spanish government for 1992.

Phillips: Carla Rahn Phillips, "Sizes and Configurations of Spanish Ships in the Age of Discovery," in *Columbus and His World*, comp. Donald T. Gerace (Ft. Lauderdale, FL, 1987).

Etayo: Carlos Etayo Elizondo, *La expedicion de la "Nina II"* (Barcelona, 1963).

** The simplest official formula for measuring ships, calculated in *codos*, was: *puntal* times *manga*, divided by 2, times *eslora*, which gave a figure in cubic *codos*. This was then divided by 8 to give a figure in *toneladas*. Tonnages were calculated before rounding off the measurements.

Table 2
Changes in Principal Ratios Over Time in Selected Spanish Theoretical Treatises
(arranged by size of beam and date)

Author	Ship Type	Year	Est. Tons	Beam	Keel to Beam	Length to Beam	Depth to Beam	Floor to Beam	Source
Diego García Palacio	*nao*	1587	400	16	2.13	3.21	.48		a
GOVT. RULES		1607	499	16	2.63	3.56	.55		b
Juan de Veas		1608	504	16	2.75	3.50	.56	.5	c
Tomé Cano		1611		16	2.75				d
GOVT. RULES	*galeón*	1613	448	16	2.75	3.5	.5		c
Manuel Fernandes	*navío*	1616	540	16	2.31	3.38	.63		e
Manuel Fernandes	*galeón*	1616	298	16	2.17	3.29	.35		e
GOVT. RULES	*navío*	1618	424	16	2.63	3.31	.5		f
Anonymous *Diálogo*		1635	528	16	3	3.67	.56	.5	g
Fernando Esqueda	*navío*	1680	463	16	2.91	3.51	.49	.49	h
Sebastián Bernal	*navío*	1680	442	16	2.81	3.45	.5	.5	h
Sebastián Ruiz de Aranda	*navío*	1687	476	16	3	3.5	.53	.5	h
Antonio de Gaztañeta	50 guns	1720	489	17	3	3.6	.45		i
Antonio de Gaztañeta	40 guns	1720	411	16	3	3.59	.47		i
GOVT. RULES		1607	663	18	2.44	3.44	.53	.5	b
GOVT. RULES	*galeón*	1613	623	18	2.67	3.42	.5		c
Manuel Fernandes	*navío*	1616	758	19	2.14	3.08	.62		e
Manuel Fernandes	*galeón*	1616	420	19	2.07	3.15	.32		e
GOVT. RULES	*navío*	1618	564	18	2.56	3.28	.47	.5	f
Anonymous *Diálogo*		1635	743	18	3	3.67	.56	.5	g
Diaz Pimienta		1645	736	19	2.97	3.62	.51	.51	j
GOVT. RULES		1666	658	19	2.86	3.51	.47	.52	k
GOVT. RULES		1666	559	18	2.86	3.54	.47	.51	k
GOVT. RULES		1679	741	19	2.95	3.55	.49	.51	k
Proposal	*galeoncete*	1680	540	18	2.67	3.33	.44	.5	h
Sebastián Bernal	*navío*	1680	635	18	2.83	3.48	.5	.5	h
Proposal	*navío*	1680	659	18	2.92	3.52	.49	.51	h
Sebastián de Roteta	*bajel*	1685	529	18	2.67	3.26	.44	.5	h
Roteta's critics		1685	684	18	3	3.6	.5	.5	h
Antonio Garrote		1691	496	18	3	3.43	.4		l
Beltran/Echevarri		1608	770	19	2.43	3.24	.6		g
GOVT. RULES	*galeón*	1613	1066	22	2.45	3.2	.5		c
Manuel Fernandes	*navío*	1616	1174	22	1.95	2.77	.64		e
GOVT. RULES	*navío*	1618	1029	22	2.41	3.09	.5		f
Anonymous *Diálogo*		1635	1331	22	3	3.67	.55	.5	g
Proposal	*galeón*	1680	1031	22	2.73	3.41	.45	.5	h
Sebastián de Roteta	*capitana real*	1680	1126	22	3	3.55	.48	.55	h
Sebastián de Roteta	*bajel*	1685	1005	22	2.73	3.32	.45	.5	h
Antonio Garrote		1691	904	22	3	3.44	.4		l
Antonio de Gaztañeta	70 guns	1720	1095	22	3	3.6	.46		i

Sources:

a) Diego García de Palacio, *Instrucción náutica para nevegar*, 1587 (Madrid: Cultura Hispánica, 1944).

b) Martín Fernández de Navarrete, comp., *Colección de documentos y manuscriptos compilados*, ed. Julio Guillén Tato, 32 vols. (Nendeln, Lichtenstein: Kraus-Thompson Organization Limited, 1971.)

c) José Luis Rubio Serrano, "Métodos de arqueo en el siglo XVI," *Revista de Historia Naval* 6, no. 24 (1989): 29-70.

d) Tomé Cano, *Arte para fabricar y aparejar naos* (1611), ed. Enrique Marco Dorta (La Laguna, Canary Islands: Instituto de Estudios Canarios, 1964).

e) Manuel Fernandes, *Livro de traças de carpintaria*, 1616 (Lisbon, 1989).

f) Archivo General de Marina, Museo Naval (AGM), C. F. 134.

g) Cesáreo Fernández Duro, ed., *Disquisiciones náuticas*, 6 vols. (Madrid: Sucesores de Rivadeneyra, 1876-81).

h) Archivo General de Indias (hereafter AGI), Indiferente General (IG), leg. 2740.

i) Eli Galdos and Luis Yáñez, et al., *Antonio de Gaztañeta, 1656-1728* (San Sebastián: Museo Naval, 1992.)

j) José Pérez Vidal, *Diaz Pimienta y la construcción naval española en el siglo XVII* (Las Palmas: Ediciones Canarias, 1936).

k) *Recopilación de leyes de los reynos de las Indias, mandadas imprimir y publicar por el Magestad católica del rey don Carlos II*, 3 vols. (Madrid, 1681), libro 9.

l) Gervasio Artiñano y de Galdácano, Gervasio, *La arquitectura naval española (en madera)* (Madrid, 1920).

Table 3

Changes in Principal Ratios Over Time on Selected Spanish Ships
(arranged by size of beam and date)

Name	Type	Year	Est. Tons	Beam	Keel to Beam	Length to Beam	Depth to Beam	Floor to Beam	Source
La Trinidad	*nao*	1585	501	16		3.1	.66		a
S. Cristóbal	*galeón*	1583	621	16		3.5	.66		a
La Magdalena	*nao*	1585	557	16		3.03	.69		a
La María Juan	*nao*	1585	655	17		3.06	.74		a
S. María del Juncal	*nao*	1586	552	16		3.13	.68		a
San Francisco	*nao*	1585	651	16		3.34	.72		a
Santa Catalina	*nao*	1585	522	16		3.07	.65		a
Santiago	*nao*	1585	624	16		3.01	.74		a
Basque ship	*nao*	1585	424	17		3.21	.47		b
Basque ship	*nao*	1601	485	16		3.19	.59		b
Owner Bertendona	warship	1603	484	17		3.21	.53		c
Owner Bertendona	warship	1603	481	16		3.22	.55		c
Owner Bertendona	warship	1603	462	16		3.31	.52		c
S.J. Baptista	*galeón*	1628	455	17	2.47	3.15	.47	.47	d
N.S. Reyes	*galeón*	1628	453	17	2.47	3.14	.47	.47	d
Santiago	*galeón*	1628	335	15	2.5	3.26	.47	.46	d
N.S. Encarnación	*galeón*	1646	542	17				.5	e
Owner Sebastián Ruiz de Aranda	*navío*	1687	476	16	3.5	.53	.5	.5	f
La Trinidad	*nao*	1586	732	18		3.04	.7		a
N.S. de Begona	*nao*	1585	802	18		3.00	.69		a
N.S. de la Rosa	*nao*	1586	856	19		3.08	.67		a
San Salvador	*nao*	1586	869	19		3.08	.67		a
Santa Ana	*nao*	1586	724	18		3.04	.69		a
Owner Bertendona	warship	1603	775	19		3.22	.58		c
Owner Bertendona	warship	1603	529	17		3.18	.51		c
N.S. Begona	*galeón*	1628	543	18	2.44	3.15	.47	.47	d
S. Felipe	*galeón*	1628	536	18	2.44	3.11	.47	.47	d
Capitana Real	*galeón*	1661	1402	24	2.83	3.66	.47	.47	f
Santiago	*galeón*	1674	1092	22	2.82	3.39	.47		f
S. Joaquin	*galeón*	1698	916	22	2.83	3.23	.45	.52	f
S. José	*galeón*	1698	899	22	2.75	3.25	.46	.47	f
Princesa	70-gun	1730	1709	27	2.62	3.32		.47	g

Sources:

a) José Luis Casado Soto, *Los barcos españoles del siglo XVI y la Gran Armada de 1588* (Madrid: Editorial San Martín, 1988), 209-215.

b) Michael Barkham, "Sixteenth Century Spanish Basque Ships and Shipbuilding: The Multipurpose *nao*," in *Postmedieval Boat and Ship Archaeology*, ed. Carl Olof Cederlund (Stockholm: Swedish National Maritime Museum, Report No. 20, 1985).

c) Archivo General de Simancas (AGS), Contaduría Mayor de Cuentas. 3a época (CMC 3), leg. 2214-7.

d) AGS, Guerra Antigua (GA), leg. 3149-2.

e) Archivo General de Marina, Museo Naval (AGM), Ms. 1311.

f) Archivo General de Indias, Seville (AGI), Indiferente General (IG), leg. 2740.

g) John Fincham, *A History of Naval Architecture: To Which is Prefixed, An Introductory Dissertation on the Applications of Mathematical Science to the Art of Naval Construction* (London: Whittaker and Company, 1851), 82.

The *Niña*, the *Santa Cruz*, and Other Caravels as Described in the *Libro de Armadas* and Other Spanish Records

EUGENE LYON

In 1979, a search in the Archives of the Indies in Seville for information about a Spanish ship which had been in Florida in the 1560s led this author to the voluminous series called *Papeles de Armada*, which describe the Indies fleets. Further curiosity led to the very first bundle in the series, AGI *Contratación, legajo* 3249, entitled the *Libro de Armadas*.[1]

This bundle consisted of two parts. The first, larger one was written in a script of the end of the fifteenth century and was a listing of expenses for the outfitting of ships sent to the Americas from Spain between 1495 and 1500. The second part was smaller, written in a more modern script, possibly of the late eighteenth century, which upon examination proved to be a copy of a portion of the first piece, up to its fol. 113.

Many researchers have cited the *Libro* — Father Angel Ortega, Miss Alice B. Gould, Juan Pérez de Tudela, Dr. Juan Gil, and Dr. Consuelo Varela.[2] In the nineteenth century document collection *Colección de Viages y descubrimientos. . .* of Martín Fernández de Navarrete and in the series *Documentos inéditos. . .*, various materials from the *Libro* appear.[3] Nevertheless, the bundle still contained important unpublished material. The reason for this may be that other readers of the *Libro* had only consulted the smaller piece, which was written in a script that was easier to decipher. Thus they may not have known of the valuable documents in the larger, older piece.

The older documents in the *legajo* contain some 240 foliated pages; some pages are missing from it. Within, however, are details about fleets sent to Hispaniola after the first two voyages of Columbus. The document includes accounts of the ships of Juan Aguado (1495), Gianotto Verardi (1496), two other caravels and a merchant ship which left in June of the same year, both parts of Columbus's third voyage, and the dispatch of Fray Francisco de Bobadilla in the year 1500.

The most interesting page, however, was a shipmaster's receipt. Written by one Pedro Francés on 24 January 1498, it furnished the details of the caravel *"Niña*, named *Santa Clara,"* which Francés had received for the voyage to Hispaniola. (See Appendix 1 on page 245.) This document, which gave many details about the sails, rigging, arms and other equipment of the *Niña*, was unpublished and unknown. Unfortunately, there is little or no other primary documentation which affords details about any of Columbus's ships; almost everything which has been written about their structure, rigging or other gear is conjectural.

However, much of the story of Christopher Columbus's famous and beloved ship, the *Niña*, is familiar. A caravel with this nickname, the property of Juan Niño of Moguer, was one of two vessels provided by the town of Palos for Columbus's first voyage. Under the command of Vicente Yañez Pinzón, she carried a completely lateen rig until the Columbus fleet reached the Canary Islands, where *Niña* was converted into a *caravela redonda*, or one with square sails on her fore and main masts. *Niña* evidently became Columbus's favorite caravel; despite fierce Atlantic storms, she carried him in safety to Spain at the end of the first voyage after the loss of *Santa María*. Aboard *Niña* Columbus, now Admiral of the Ocean Sea, returned in triumph to Palos in March 1493. A caravel called *Niña*,

1. Archivo General de Indias (hereinafter AGI) *Contratación* 3249 (hereafter *Libro.)* The bundle bears the subtitle of "Second Book." It appears that the series once followed the standard format of *Libros Manuales* and *Libros Mayores*, but many sections are now missing. Within the *Libro de Armadas* reference is made to other books of account (fol. 13vto. et passim).

2. Padre Angel Ortega, *La Rábida - Historia documental crítica* (Sevilla: Imprenta y Editorial de San Antonio, 1926); Alice B. Gould, "Nuevos datos sobre Colón y otros descubridores," *Boletín de la Real Academia de la Historia* (hereafter BRAH) 76 (1920): 201-214; Juan Pérez de Tudela Bueso, *Las Armadas de Indias y los Orígines de la Política de Colonización (1492-1505)* (Madrid: Instituo Gonzalo Fernández de Oviedo, 1956), 34. See also Juan Gil, "El Rol del Tercer Viaje Colombino," en Juan Gil y Consuelo Varela, eds., *Temas Colombinas* (Sevilla: Escuela de Estudios Hispano-Americanos, 1986).

3. Martín Fernández de Navarrete, *Colección de viages y descubrimientos que hicieron los españoles...*, 5 vols. (Madrid, 1825-1837); *Colleción de documentos inéditos relativos al descubrimiento, conquista y organización de las antiguas posesiones españoles de América y Oceania. . .*, 42 vols. (Madrid, 1864-1884), 1: 38, 394, 396.

with the formal name of *Santa Clara*,[4] also sailed on the Admiral's second voyage.

Once in the Indies again, Columbus found his colony at Navidad deserted, its colonists all dead. He then founded the town of Isabela, now being excavated by archaeologists from the Dominican Republic, Venezuela, and the University of Florida.[5] He purchased two of the caravels from the fleet, sending the rest home to Spain. Still seeking the riches of Cipangu and Cathay, Columbus embarked on further voyages of discovery. With *Niña* as flagship, he sailed to Jamaica, and coasted along Cuba's south shore. There, on 12 June 1494, aboard *Niña*, he anchored and made his crews swear that they had reached the mainland of Asia. Seriously ill, Columbus returned to Hispaniola in the *Niña*.[6]

The *Libro de Armadas* recounts many of the subsequent adventures of this sturdy little caravel. One page describes the havoc caused at Isabela by a 1495 hurricane, which sank the four Aguado caravels and two others and drove little *Niña* ashore.[7] She was rebuilt there, and another new caravel was made from the wood of the shipwrecked vessels — *Santa Cruz*, or (to give her nickname) *La India*. Together, the two little ships left Isabela in 1496 for Spain, overloaded with the Aguado crews and others and commanded by Christopher Columbus. When they reached Spain, the two caravels went in for refit.[8]

When he returned to Spain, Columbus found that criticism of his administration of the colony in Hispaniola had preceded him. Much of the enthusiasm for the Indies had evaporated, and it was difficult for Columbus to get royal support for his next voyage. In the meantime, the *Niña* was sent on a voyage to Rome. Bishop Juan de Fonseca authorized the commercial voyage, under the command of master Alonso Medel, without Columbus's approval. On her return voyage in 1497, a fleet of six French corsairs captured the little caravel as she left Sardinia. The pirates stripped the ship, removed her crew, and anchored for the night. Master Medel bribed three of the corsairs with thirty gold ducats to let the Spaniards escape. Diving into the sea, they swam to the *Niña*, woke the sleeping French guards, and pushed them overboard. Then the Spaniards cut the anchor lines and set sail for Spain.[9]

Furious at this misadventure, Columbus filed a lawsuit to reclaim *Niña*, successfully recovered her, and sent the caravel, together with *Santa Cruz*, to be prepared for another Indies voyage. He changed the masters of both caravels, appointing Pedro Francés to command *Niña* and Juan Bermúdez to command *Santa Cruz*.[10] Columbus was then ready to begin preparations for the 1498 voyages. A sizeable section of the *Libro de Armadas* (folios 141-181) is devoted to the preparations for these journeys.

The third voyage of Columbus actually contained two components. The Admiral's agreement with the Crown, signed 23 April 1497 after some negotiation, granted him permission to sail with 330 salaried colonists. The *Libro* contains royal orders releasing two million *maravedís* for the journey. Early in 1498 two ships were readied to take supplies to Hispaniola; the other contingent of ships departed under the Admiral's command late in the spring. This voyage was a mixed enterprise. Columbus shared with the Spanish Crown the ownership of the first two caravels which sailed — the *Niña*, or *Santa Clara*, and the *India*, or *Santa Cruz*. The Crown paid for ship repairs and outfitting, supplies and salaries of those aboard, and payments to shipmasters. Some officials and merchants were allowed to load supplies for sale in the Indies for their own account.

In marked contrast to the enthusiastic volunteers who had flocked to sail on the second voyage, it was difficult for Columbus to recruit sailors for the third journey. Some who had still not been paid for their part in the second voyage insisted upon repayment before they would enlist for the third.[11] Columbus sent out criers to describe the voyage in Galicia, at Guadalajara, at Burgos, and in Vizcaya, and to announce the King and Queen's decree of pardon for convicted murderers if they would sail aboard *Niña* or *Santa Cruz*.

4. The ship was named for the patron saint and devotion of the monastery of Moguer, Santa Clara.

5. Kathleen A. Deagan, "La Isabela, Foothold in the New World," *National Geographic* (January 1992): 40-53.

6. AGI, *Patronato* 8, *ramo* 11. The document has also been reproduced in Martín Fernández de Navarrete, *Colección de los viages y descurbimientos que hicieron por mar los Españoles desde fines del siglo XV . . .*, 5 vols. (Madrid: Imprenta Real, 1825-1837), 2, no. 76, 171-178.

7. *Libro*, fol. 103.

8. The costs of repair and refit for the caravels is described in the *Libro*, fol. 112, 133-133vto., and 141.

9. *Libro*, fol. 113-113vto.

10. Columbus paid attorney Martín de Almonte for his work in preparing the lawsuit; *Libro*, fol 150. The Crown granted Columbus the right to recover the caravels; see the royal order to the Asistente of Seville and judicial authorities of Andalusia, dated at Medina del Campo on 22 June 1497, from *Colección de documentos inéditos relativos al descubrimiento, conquista y organización de las antiguas posesiones españolas de America y Oceana, sacadas de los Archivos del Reino y muy especialmente del de Indias*, 42 vols. (Madrid: Real Academia de la Historia, 1864-84, hereafter DI), 38: 392. The matter is also discussed by Alice Gould in articles in BRAH 85, no. 1, 34-39 and no. 2, 145-149.

11. Columbus describes his difficulties in recruiting crews for the third voyage in his statements of 27 November and 4 December 1497, *Libro*, fol. 224 vto.

Shipmaster Francés's receipt from the *Libro* furnishes significant detail about Columbus's littlest caravel. It reveals, for instance, that the vessel had a bowsprit and four masts. She had two boomlets, one each fore and aft. She carried fore, main, mizzen and countermizzen (or bonaventure) sails, with two bonnets for the mainsail and one for the foresail. She also carried a spare set of new main and foresails, made of Portuguese canvas. Her standing rigging included six shrouds on either side of the mainmast, four on each side of the foremast and, for the mizzen, three per side. Her hemp lines included sheet-ropes, tie-runners, bowlines, and lifts, with preventer-sheets, main-runners and pendants. She had rope ladders, deadeye lanyards, and sixty-eight blocks and pulleys of varying sizes. *Niña* also carried a ship's boat with six oars.

Niña's major weapons were listed as ten *bombardas*, with breechblocks, wedges, and a hammer for the wedges. The word *bombarda* could be taken to mean a breech-loading deck gun; however, the description went on to include the words *molynetes*, a kind of turning device. At issue, therefore, was the question: were these lombards, or were they rail-mounted swivel guns or falconets? The answer to this question held implications for ship size, for the siting and serving of ten lombards would require substantial deck or hold area. The word *molynete*, however, appeared to mean the swivel yoke of a rail gun.[12] A 1496 enactment, repeated in the *Libro*, required each caravel to carry ten such *bombardas* on each Indies journey.[13]

Niña also carried eighty lead balls for the guns, fifty-four long and twenty short lances, a template for measuring the cannonballs, and a hundred pounds of gunpowder. She was further equipped with an axe, an adze, a saw, and a caulking iron, and she carried one large and two small anchors, a boathook, and a funnel.

The *Libro* also describes the lading of *Niña* and *Santa Cruz* on the 1498 voyage.[14] *Niña* carried wheat and wheat flour, wine, seabiscuit, olive oil, and garbanzo beans, cheese, salt pork, vinegar, sardines, and, not surprisingly, garlic. For ship repair, she also carried a supply of oakum.

The total weight of this cargo was 52.84 *toneles*, comparable to the 51 *toneles* carried on the caravel's trip to Rome.[15] This shows her burden to have been in the neighborhood of 55-60 tons. This corresponds well with Michele de Cuneo's estimate of the size of the *Niña* and the other vessels in Columbus's 1494 exploration of Cuba and Jamaica — sixty tons and below.[16]

The supply list page was notable for something else; it contained a marginal note about the disposition of the *Niña* in 1499 in Hispaniola. On 9 October of that year, the note ran, Francés had followed Columbus's order and had turned over the caravel to one Diego Ortiz for some consideration. Elsewhere in the *Libro*,[17] Diego Ortiz appears as the representative of Bartolomé de Leza, one of Aguado's caravel captains in 1495. He may have been the same man who, serving as pilot of the *Capitana* of the Bobadilla fleet, was lost at sea during the hurricane which destroyed that fleet.[18] As the reader may recall, the last months of 1499 were difficult times for Christopher Columbus in Hispaniola. He had been forced into a humiliating agreement with the rebel Francisco Roldán and may have found it necessary to sell the beloved caravel.

These data in the *Libro* offer substantial information about the *Niña:* her sail and rigging plan, ground tackle, arms, tools, and supplies. The information appears to involve interpretations quite at variance with other reconstructions of the *Niña*, whether made on paper only or embodied in model or full-scale reproduction.

For example, the *Libro* documents disclose that the bonaventure mizzen, or *contramezana*, was in use in 1498 in both caravels which sailed in the first part of the third voyage of Columbus. Thus the *Niña*, depicted in most of the reconstructions with two or three masts, had four masts in 1498. It is noteworthy that the official Spanish version of *Niña*, designed by Capitán de Fregata José María Martínez-Hidalgo, does not display the sail plan disclosed by the document from the *Libro de Armadas*, despite the fact that the writer personally furnished Captain Martínez-Hidalgo a copy of the *Niña* document from the *Libro* in 1985.[19] Neither does the *Niña* III, the latest version constructed after the design of Captain Carlos Etayo Elizondo, have four masts. However, the *Niña* replica built in Valença, Brazil, following the design of John Sarsfield, does carry the

12. Paul E. Hoffman found a 1564 contract for making bronze *falconetes* with *molinetes;* this was from AGI *Contratación* 58, *ramo* 1, no. 1, 13.

13. Contract between Bishop Juan de Fonseca and García Alvárez et al., 14 March 1496, from the *Libro*, fols. 115vto.-116.

14. *Libro*, fol. 176. Appendix 2.

15. *Libro*, fol. 113.

16. Spanish version of the Cuneo narrative is found in Juan Gil and Consuelo Varela, *Cartas de particulares a Colón y Relaciones coetáneas* (Madrid: Alianza Universidad, 1984), 252.

17. *Libro*, fol. 3vto.

18. Ortiz is mentioned in Alice B. Gould in *Nueva lista documentada de los tripulantes de Colón en 1492* (Madrid: Real Academia de la Historia, 1984), 345.

19. Sociedad estatal del Quintocentenario, "Construcción de replicas de las Naves del Descubrimiento," (Madrid, 1990); José María Martínez-Hidalgo, *Columbus's Ships*, ed. Howard I. Chapelle (Barre, MA: Barre Publishers, 1966), 87-99.

four masts described in the *Libro de Armadas*.[20]

To store the wheat, barley, biscuits, garbanzos, and almonds carried aboard the *Niña* in 1498, the refitters framed in chestnut-wood *pañoles*, or orlops. These orlops were lined with esparto-grass mats; *Niña*'s required twenty-one mats. Cargo stowed in the main hold, including tuns and pipe barrels of wine, were shored in place with bundles of firewood, pieces of cork, sheaves of vine-shoots, and wooden rollers.

The *Libro* also described the human cargoes aboard *Niña* and *Santa Cruz* in 1498. The fleet's commander was one of Columbus's most trusted associates, Pedro Fernández Coronel, who had served the Admiral as a regent on his Council at Isabela in 1494 and had also served as *alguacil* on Hispaniola. The two caravels carried ninety persons on royal salary, including eighteen farmer-settlers, fifty crossbowmen, and a surgeon. Ten convicted murderers, freed in compliance with a Crown decree which allowed such persons to emigrate to the Indies, went aboard. Two of those, María and Catalina, were Gypsy women.[21]

The information found in the *Libro* about the *Santa Cruz* is in some ways more detailed than that about the *Niña*. She carried a similar four-masted rig and parallel items of cargo, arms, and other equipment. However, the data about the standing and running rigging are more complete and assign particular blocks and sheaves for certain sails. *Santa Cruz* also featured a device known as *cargadera*.[22]

It may be that the *Santa Cruz* survived into the sixteenth century. In a list of early sixteenth-century Indies traffic, a royal caravel bearing that name sailed from Puerto de Plata to Puerto Real in Hispaniola. It could have been the same as the *Santa Cruz/La India* which sailed in 1498.[23]

The *Libro de Armadas*, which furnished information about the *Niña*, the *Santa Cruz*, and other vessels, was written before the genesis of the Spanish House of Trade *(Casa de Contratación)* in 1503. The primitive arrangements for the governance of Indies commerce and supply, the disbursement of Crown funds, and fiscal relationships with Columbus were handled for Isabella and Ferdinand through Bishop Juan de Fonseca and various paymasters.[24]

The *Libro* entries contain a wealth of material of interest for anthropology and archaeology, since they offer data about material culture items sent very early to the Indies. Moreover, its pages spell out the places of origin for the foodstuffs and other supplies and equipment purchased for the voyages; this demonstrates the economic impact upon Castile of the efforts of Bishop Fonseca and the other agents and factors of Ferdinand and Isabella. For example, pitch to dress the hulls of the Aguado caravels was brought from Vizcaya and the island of Ibiza to Port Santa María and from there to the ships.[25] They shipped fatback from Cabeza la Vaca, Monasterio, and Fuente de Cantos in the province of Badajoz. The fatback was washed with lye from the Triana soapworks, rolled in red clay and bran to create a protective crust, marked with a hot iron and packed into pannier baskets to be loaded aboard the ship. Wine for the caravels came from Guadalcanal, Alanis, Cazalla, and Villalba del Alcor in the present province of Huelva.[26] The first of many lists of medicines sent to the Indies appears in the *Libro*[27] and affords data about the Castilian pharmacopaea at the end of the fifteenth century. Furthermore, in its section about the ill-fated 1496 expedition of Giannoto Verardi, the *Libro* contains some tidbits about Amerigo Vespucci. For instance, Vespucci evidently sailed for the Indies in 1496 aboard one of the caravels of Verardi, which sank shortly after their departure, and went ashore along the Andalusian coast.[28]

An essential historical question is at issue here: Is the *Niña/Santa Clara* of the second and third voyages of Christopher Columbus the same caravel as that of his first journey to the Indies in 1492? Certainly the information about the *Niña* in the *Libro de Armadas* is far less interesting if it does not pertain to the famous ship of Christopher Columbus's first voyage. There are many opinions on this vexed question, both pro and con. For instance, Antonio Ballesteros Beretta does not believe the later caravel to be the same ship which sailed in 1492, but says that "many believe it to be the

20. John P. Sarsfield, "From the Brink of Extinction: Mediterranean Moulding in Brazil," *Wooden Boat*, no. 66 (1985). Cf. Columbus Foundation, "The Story Behind the Ship," (Tortola, British Virgin Islands, 1990), 1-9.

21. Payroll, *Niña* and *Santa Cruz*, *Libro*, fol. 148vto.-175vto. Juan Gil has written about the crew lists of the ships in "El Rol del Tercer Viaje Colombino," in Gil and Varela, *Temas Colombinos* (Seville: Escuela de Estudios Hispano-Americanos, 1986), 1-28.

22. When the writer expressed puzzlement at this term, Professor Carla Rahn Phillips of the University of Minnesota kindly pointed out that this was a device for hauling sail.

23. AGI, *Justicia* 990, piece 1 (no foliation).

24. A good description of the first efforts at financial control in the Indies is found in Ismael Sánchez-Bella, *La Organización financiera de las Indias* (Seville: Escuela de estudios Hispano-Americanos, 1968), 9-14.

25. *Libro*, fol. 19.

26. *Libro*, fol. 17.

27. *Libro*, fol. 31 et seq.

28. In the description of the salvage of the Verardi ships appears the following: ". . . they took two pipes of wine salvaged from that which Merigo Bespuche carried in the ship of Juan de Sesueta, lost at Rota," *Libro*, fol. 121.

same."[29] On the other hand, Captain José María Martínez-Hidalgo, Miss Alice B. Gould, and Admiral Samuel Eliot Morison all believed that there was only one *Niña*.[30]

An important proponent of the two-*Niña* hypothesis is a retired Spanish naval officer, D. Carlos Etayo Elizondo. In 1962 and 1992 he sailed reconstructions of the *Niña* in valiant transatlantic voyages. Captain Etayo believes that the sizes of the the 1492 and the later *Niñas* were quite different, and he asserts that the caravel which headed the expedition to Cuba and Jamaica in 1494 was quite large, while the discovery caravel *Niña* was much smaller. Moreover, states Etayo, the "second *Niña,*" being "very old" in 1495, could not be the same caravel as that of the first Columbian voyage, since he believes that one to have been launched just a few years before 1492.[31]

Captain Etayo's theory implies the coexistence of two *Niñas;* one, the older of the two, was launched just before the first voyage and thus could not have been considered "very old" by the time of the 1495 hurricane at Isabela. It seems doubtful, however, that in the relatively small world of Andalusian/Indies trade at that time, there could have coexisted two caravels belonging to the same family (the Niños of Moguer) with the same nickname. Moreover, we know that the average life of a wooden ship in the Indies trade was five to seven years.[32] Who could say that the *Niña*, already in 1495 the veteran of three transatlantic voyages, survivor of many powerful storms, could not be termed "very old?"

One can clearly trace the *Niña* of the second voyage from 1493 to 1499. There seems no doubt that the *Niña/Santa Clara* aboard which the "Cuba is mainland" declaration was made in 1494 is the same vessel which was remade after the 1495 hurricane at Isabela. In turn, a chain of evidence links that ship to the one which Columbus commanded in his 1496 return to Spain from Hispaniola. It is also the ship which was taken to Rome, reclaimed by Columbus, refitted in Palos, and sent on in the February 1498 voyage to Hispaniola. It is the same ship which Columbus disposed of in October 1499 at Hispaniola,[33] and it is the same *Niña* which departed Palos on 3 August 1492 on Columbus's first voyage.

A number of *Niña* replicas have been built over the years.[34] The Spanish government replica for the Quincentenary was designed by Captain Martínez-Hidalgo.[35] Within the same year of 1992, in fact, three *Niña* replicas were scheduled to visit North America: the Spanish government (Spain '92) ship, the Sarsfield replica, and Captain Etayo's *Niña* III.

Clearly, the size of the *Niña* has always been an issue; indeed, its tininess has been one of its distinguishing features and figured in the dispute over whether or not there were two distinct caravels with the same name. At question is the relative size of the *Niña* compared with contemporary vessels of the same time. The *Libro de Armadas* provides tonnages for the *Santa Cruz* and other similar ships. The cargo loaded aboard *Santa Cruz* in 1498 was 67½ *toneladas*. The Aguado ships mentioned in the *Libro*'s accounting for their 1495 voyage to the Indies were respectively of 67⅓, 79½, 77, and 104¼ *toneladas*.[36] In the ill-fated 1496 Verardi fleet, Bartolomé Collín's caravel was "above 100 *toneladas*" while the other three were "smaller."[37]

Another document, the *Libro Mayor* of Sancho de Matienzo, also lists shipping capacities for vessels in the early 1500s. It describes the caravel *Santa María* in 1514, as being of "sixty tons burden," the *Santiago*, of 65 tons, and *La Borbola*, of "90 tons, more or less."[38] That source also affords data about the rigging, arms,

29. Antonio Ballesteros Beretta, *Cristóval Colón y su Descubrimiento de América* (Barcelona and Buenos Aires: Salvat Editores, S.A., 1945), 161.

30. Martínez-Hidalgo, *Columbus's Ships*, 89; Alice B. Gould, "Nueva Lista documentada de los tripulantes de Colón," BRAH 88, p. 741, n. 2; Samuel Eliot Morison, *Admiral of the Ocean Sea* (Boston: Little, Brown and Company, 1942), 395.

31. Carlos Etayo Elizondo, *Santa María, Niña, Pinta* (Pamplona, 1962), and "La *Niña* del viaje del descubrimiento era diferente que la del segundo viaje colombino," *Revista General de Marina* (October 1970): 383-394. See also Antonio Sagaseta de Llurdoz y Galbete, *La* Niña *II* (Barcelona, 1962). Captain Etayo has also recently published *La Verdad sobre la Santa María, Pinta y Niña* (Pamplona, 1991).

32. Carla Rahn Phillips, verbal communication to author, 23 September 1988; see also Pierre and Huguette Chaunu, *Séville et l'Atlantique*, 10 vols. (Paris: S.E.V.P.E.N., 1955-59), especially the "Age" column in "Le Trafic," vols. 2-4.

33. The following items in the chain of evidence appear in the *Libro:* ". . . the said Admiral and other people mentioned above returned in two caravels; one the caravel *Niña*, which was renovated in the Indies; the other named *Santa Cruz*, which was made of the wood from the said four caravels and of two others which were sunk with them, which were earlier in the Indies," fol. 103, and ". . . *Santa Cruz*, which was made in the Indies, of which Bartolomé Colín (was master); the other named *La Niña*, which was re-made in the Indies, of which Alonso Medel is master," fol. 112. From fol. 141: "Expense in repairing the two caravels *Santa Cruz* and *Santa Clara*, which belong to Their Majesties, which were brought from the Indies the year of 96, one named *Santa Cruz*, newly made, and the other named *Santa Clara*, which was remade, that was very old."

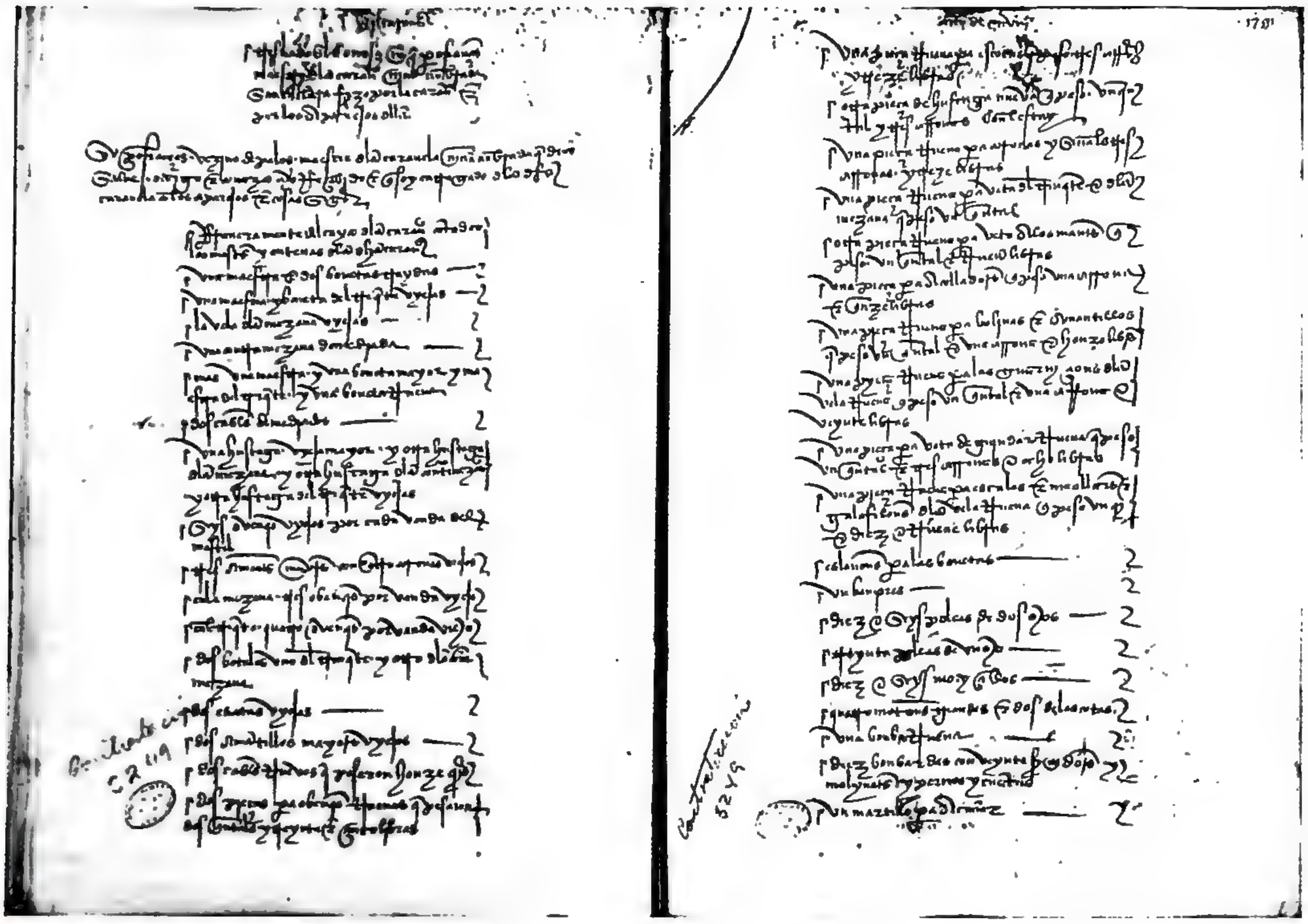
34. See Roger C. Smith "Replicating the Ships of Columbus," *Archaeology* (May/June 1992): 38-41.

35. Martínez-Hidalgo, *Columbus's Ships*. For a description of Martínez-Hidalgo's methodology, see Peter Stanford, "Columbus Rediscovered: In Quest of Ships for the Voyage," *Sea History* 54 (Summer 1990): 18-22.

36. *Libro*, fols. 2-5.

37. *Libro*, fol. 64vto.

38. AGI, *Contratación* 4674, Book 3, fols. 461-465.



Pedro Francés's receipt for the *Niña*, from AGI *Contratación* 3249, fol. 178vo - 179vo.

and other equipment carried aboard caravels at that time.

The unit of measurement for the cargo or burden of these early ships, the *tonel* or *tonelada*, is itself in dispute. The word had its origin in a vessel's capacity in wooden wine barrels, or tuns, the measure of lading. But it has generally been maintained that the caravels of the discovery period were measured in the smaller Seville *tonelada* rather than the larger Biscayan measure.[39] It is quite clear from the *Libro de Armadas*, however, that the measurements described within it are all in the *tonel macho*, or the Biscayan tun. In the Aguado, Verardi, and 1498 fleets, this was the unit in force.[40] This fact may not have been properly taken into account in the historic reconstructions of the Columbus ships and may thus have distorted their size.

39. For instance, see Martínez-Hidalgo, *Columbus's Ships*, 40.

40. Contracts with the shipmasters for Aguado recites the payment for lading, "counting for each *tonelada* which is understood to be a *tonel macho*, with two pipes per *tonel*. . ." *Libro*, fols. 1, 87vto., 142.

In any event, the study of these ships has been an absorbing one. The *Niña*, the *Santa Cruz*, and their sisters proved their seaworthiness during the Atlantic traverse they made not once, but many times. Learning more about these little caravels only increases our impression of their stout honesty. Perhaps only the men who sailed these ships were more remarkable than the ships themselves, in that great age of exploration five hundred years ago.

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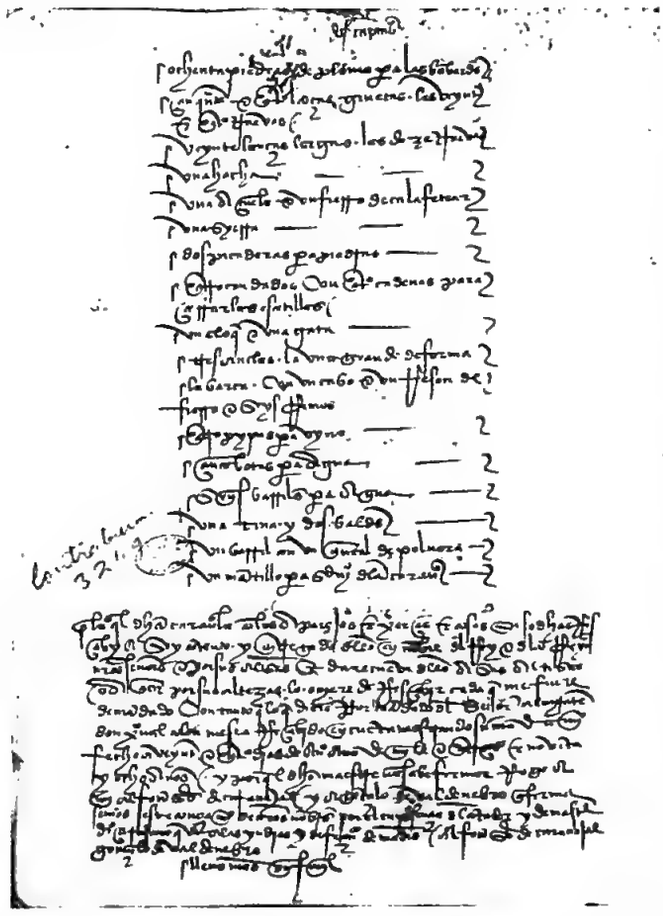


Appendix 1
Receipt for the Caravel *Niña* and its Equipment[41]

Pedro Francés, citizen of Palos, master of the caravel *Niña*, which God preserve, grant and recognize having received and that I am given the said caravel, with the following things and equipment:

First, the hull of the caravel, with all the masts and yards of the said caravel.

A mainsail and two bonnets, worn.

A main and and bonnet of the foremast, old.

The mizzensail, old.

A countermizzen sail, worn to half its original value.

Plus a mainsail and a main-bonnet and a foresail and a new bonnet.

Two cables, worn to half their original value.

An old main tie-runner, and another tie-runner of the mizzen, and another tie-runner of the counter-mizzen, and another tie-runner of the foresail, (all) old.

Six old shrouds for each side of the mainmast.

Three main runners with four pendants, old.

On the mizzen, three shrouds per side, old.

On the foremast, four shrouds per side, old.

Two boomlets, one of the foremast and the other of the counter-mizzen.

Two old sheet-ropes

Two old main-lifts.

Two new cables, which weighed 11 quintals.

Two new pieces(of line) for shrouds, which weighed two quintals 35 lb.

A new piece for sheet-ropes, which weighed three *arrobas* and 13 lb.

Another piece of new tie-runner, which weighed one quintal and three *arrobas*, with the stay.

A new piece for pendants and (which weighs?) three *arrobas* and 13 lb.

A new piece for lines for tackle of the fore and mizzen.

Another new piece for lines to the runners, which weighed one quintal and nine pounds.

A piece for deadeye lanyards, which weighed one *arroba* and 11 lb.

A piece for the bowlines and lifts, which weighed one quintal and one *arroba* and 11 lb.

A new piece for the facing of the new sail, which weighed one quintal and one *arroba* and 20 lb.

A new piece for tackle-lines for swaying-up, which weighed one quintal and; three *arrobas* and 8 lb.

A new piece for rope-ladders, spun yarn and lashing-lines of the new sail, which weighed one quintal and 19 lb.

Tie loops for the bonnets.

A bowsprit

16 blocks (pulleys) with two eyes

30 blocks with one eye

16 small blocks

4 large blocks and two of the sheets

A new pump

10 *bombardas* with 20 breech-blocks, and with turning cylinders, bolts and wedges.

A hammer for the wedges.

80 lead cannonballs (literally *piedras de plomo* — "stones of lead")

54 short lances, 24 of them new.

Twenty long lances, 12 of them new.

An axe.

An adze and a caulking iron.

A saw.

Two templates for (measuring) the cannonballs.

Four locks with four chains for securing the hatches.

A boat-hook or garr and a cat-head.

Three cast anchors, one large.

The small boat, with one line, an iron grapnel anchor and six oars.

Four pipes for wine.

Five casks or butts for water.

Six barrels for water.

A large earthenware jar and two buckets.

A barrel with 100 lb. of gunpowder.

A hammer for use aboard the caravel.

41. Copy of the receipt which Pedro Francés, master of the caravel *Niña*, named *Santa Clara*, made for the caravel and its equipment, AGI *Contratación* 3249, fol. 178vto.-179vto.

Which said caravel, with the equipment and rigging and above-mentioned things, I received and am satisfied, and it has been turned over to me in the name of the King and Queen, Our Lords, and for their Highnesses, and I will give account of it to their Highnesses, or to whomever must receive it for their Highnesses, each (thing) that might be demanded of me, with so much that that which may be given by order of the Señor Admiral Don Cristóval Colón might be received for me in account, showing his order. Done at 24 days of (January) of 1498 years. And because the said master did not know how to sign, he asked me, Alfonso de Carvajal and (me), Gonzalo de Valdenebro, that we might sign this receipt with our names for him. In presence of the Accountant and of Master Diego, Surgeon, who go to the Indies. (signed) Alfonso de Carvajal; Gonzalo de Valdenebro.

It also carried a funnel.

Appendix 2
Cargo of the *Niña*, or Santa Clara, on the 1498 Voyage

The things which I, Pedro Francés, master of the caravel *Niña*, received — by order of the King and of the Queen, Our Lords, to carry in the said caravel to the islands of the Indies, which things I will give there to whoever, by Their Highnesses' (order) should receive them — are the following:

Wheat: 34 *cahizes*
Wine: 31 pipes
Biscuit: 100 quintals
Olive oil: two *cuartos de tonel*
Garbanzos: 2 *cahizes*
Cheeses: 665, which weighed 2377 lb.
Flour: 18 large burlap sacks, which weighed 4375 lb.
Salt Pork: 12 pannier-baskets and one pannier-basket of garlic, which all weighs 2450 lb.
Oakum: 1 large bale; it weighed 182 lb.
Three tuns for water
Mats: 21, for the hold-compartments

The things which I also received, in addition to those of the King, which are of some private persons, are the following:

Of Valdenebro:
Wine: three pipes
Olive oil: a *cuarto de tonel* and 80 *botijas*, filled
Wine: also three *cuartos de tonel*
Vinegar, one *cuarto de tonel*
Pig's feet: three pannier-baskets which weighed 625 lb.
Cheese: 1500 lb.
Garlic: 1 sack
Olive oil: 1 barrel of 400 lb.
Beans and Garbanzos: 6 *fanegas*

For Rafael Cataño
Biscuit: 1 pannier-basket and two small barrels, which all weighed 150 lb.

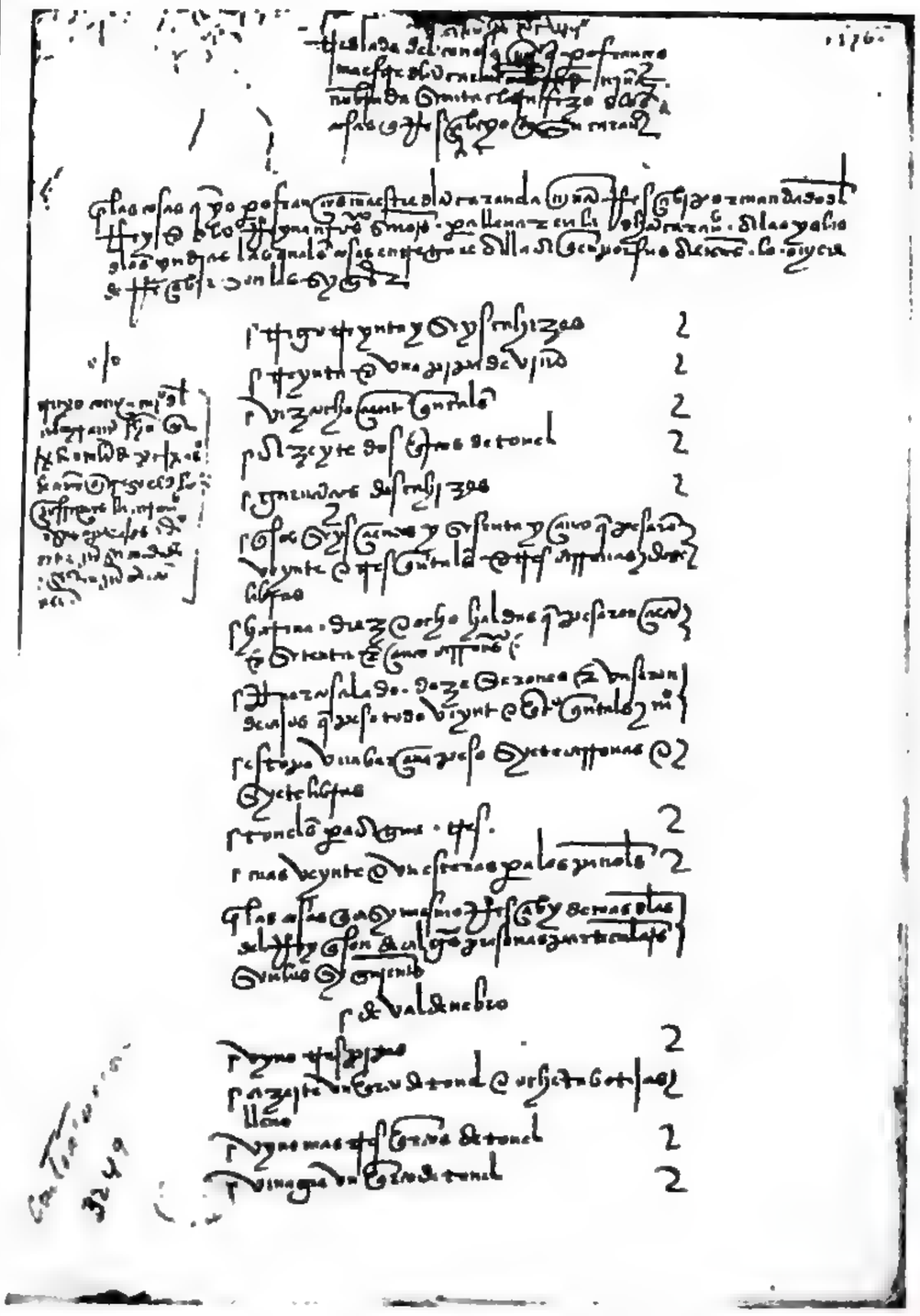
For Bartolomé de Mesta
Biscuit, Cheese and Fatback: 100 lb.

Gil Delgadillo
Cheeses: three pannier-baskets; 346 lb.
Sardines: 1 *cuarto (de tonel)*

Diego Descobar
Sardines: 1 tun
Cheese and Raisins: one-half tun
He also carried forty-five(?) bundles of willow withes
Signed and dated in Seville 23 January 1498

(Note: The cargo totalled 52.84 *toneles machos*, close to the cargo carried by the caravel on her trip to Rome the year before. Two pipes equalled one *tonel;* with wheat, barley and other similar commodities, two *cahizes* equalled one *tonel. Cuartos* and *barriles* were smaller containers than the tun. *Niña*'s supplies were largely paid for by the Spanish Crown, to be sent to the colonists on Hispaniola. A few private entrepreneurs were, however, permitted to send their own shipments aboard.)

The marginal note on this page reads: "Attention: He brought a receipt of the Admiral, dated 9 October 1499, of how he, the said Pedro Francés, delivered the caravel and its equipment to Diego Ortiz by his order and that he [Columbus] declared the transaction satisfied."



Supply list of *Niña*, 1498, with a marginal note about the disposition of the vessel in 1499, from AGI *Contratación* 3249, fol. 176.

Northern Ships and the Late Medieval Economy

RICHARD W. UNGER

The discussion of Columbus and the important events of 1492 does not normally include any examination of the maritime history of northern Europe and specifically of ships in that part of Europe. Concentration is invariably on developments in the Mediterranean and in Iberia in the later Middle Ages, where the navigational techniques of those oceanic sailors were developed and where those men gained their early training in sailing. Northern Europe is usually and correctly seen as peripheral to advances in navigation as well as in the design and construction of seagoing ships.

The usual reason for studying the economy and shipping of northern Europe, however, is that the economic, commercial, and demographic focus of the continent shifted from the Mediterranean to northwestern Europe in the sixteenth and especially in the seventeenth century. By 1700 Europe's largest cities, fastest growing economies, and greatest shipping fleets were to be found along the shores of the North Sea and English Channel.[1] During Columbus's lifetime, however, England, the Low Countries, northern Germany, and northern France were still very much on the edge of Europe, both economically and politically.

Despite those facts, there are at least three reasons why any discussion of the maritime history of the fifteenth century should include some discussion of northern European ships. First, voyages made from the British Isles and Scandinavia in the Middle Ages made a contribution to the European conquest of the sea. How much of a contribution the Irish and Vikings of the early Middle Ages made is very much a subject of controversy, but the discussion must be about extent or quality of their influence rather than about the fact of influence. Second, northern Europeans proved themselves capable of taking advantage of Columbus's voyages of exploration very quickly. The trips across the North Atlantic by John Cabot and his son, Sebastian, were matched, and in large numbers, almost immediately by many Norman fishermen going after cod near the coast of Newfoundland. English fishermen and traders from Bristol were not far behind. Third, the technology of shipbuilding in northern Europe made a significant contribution to the development of designs and building methods used for the ships of Columbus and for other explorers and shippers making long-distance deep-sea voyages. As a result of regular and increasing contact and, along with that, the exchange of technical knowledge among all parts of Europe from the early fourteenth century, a series of common ship types emerged which in turn created the basis for the highly effective and efficient European seagoing sailing ships of the next three or four centuries. This contribution of northern European shipbuilding to the development of the distinctive and ultimately technically superior ship emerged, in turn, from the unique demands placed on shipping in the fourteenth and fifteenth centuries, demands created by major changes in the economy.

Historians have tended to blame the Black Death of 1346-1350 for virtually everything that happened in and to the economy of Europe in the fifteenth century. The pandemic which spread from the Black Sea littoral to Italy, Iberia, and England and then to France, the Low Countries, and Germany, generated a population loss in just four years of something on the order of 40 percent. It seems inconceivable that the economy was not disrupted in the short run and very possibly in the long run as well. The recurrence of plague outbreaks for the rest of the century and well into the fifteenth century tends to confirm the belief that the economy would not have escaped. The now-orthodox view of that disruption grew out of macroeconomic ideas of the 1950s and 1960s. It has often been challenged and, in some aspects, revised but remains largely intact.[2]

The readjustment after the Black Death and in the wake of subsequent periods of high mortality down to the mid-fifteenth century led to falling grain prices as the surviving farmers concentrated their efforts on only the most productive soil. The shift led in turn to the

1. For example, see Richard W. Unger, "The Tonnage of Europe's Merchant Fleets 1300-1800," *The American Neptune* 52, no. 4 (Fall 1992), 247-261.

2. Harry A. Miskimin, *The Economy of Early Renaissance Europe, 1300-1460* (Englewood Cliffs, NJ: Prentice-Hall, Inc., 1969).

desertion of many agricultural holdings. The decline in population decreased the number of mouths to feed and with that the demand for grain, the demand falling faster than the supply. Meanwhile, the inability to replace skilled workers quickly, if at all, led to rising prices for industrial goods. Industrial goods were almost completely made by hand — there was true manufacture — and so supply depended on having trained individuals to do the work. The education of workers took time and knowledgeable individuals to teach them. There were few of the latter left, especially since mortality rates were higher in towns than in the countryside. During the many years it took to train new workers, Europeans had to accept lower quality goods and higher prices for those goods.

On the other hand, agricultural raw materials cost less. The greater efficiency of farmers, the shift to less labor-intensive forms of production in the countryside in order to use land otherwise deserted, and the fall in the population all made goods like wool cheaper within a few decades. The combination of price changes in agricultural and industrial goods produced a swing in the balance of payments between the country and towns, to the advantage of the latter. Money drained from the countryside to the towns in the years after 1350.

There was also an increase in the consumption of luxuries per person because of increases in incomes per person and because of changes in income distribution which favored certain groups, including some skilled workers and some merchants. To enjoy their rising real incomes, such men and women turned to buying better and more varied foods and clothes. In some cases the difference was as simple as having another measure of beer now and again. In others the difference was the purchase of works of art or fine garments brought from afar. The increase in purchases of luxuries led to a rise in imports into northern Europe from Italy, generating a long term balance of payments deficit for the North. That in turn led to a chronic specie shortage in England, France, and the Low Countries until late in the fifteenth century.[3]

All those adjustments in the economy meant that after 1350 the market for shipping services changed as well. Rising real wages which were typical of the period for many workers made shippers and shipbuilders more conscious of costs, and especially labor costs, both in the construction and in the handling of ships. It proved advantageous to be able to carry goods over longer distances (that is, without increasing costs) in order to be able to reach more markets both within northern Europe and beyond. Speed, always a consideration, became even more important as the faster movement of goods, especially luxuries, enjoyed greater relative rewards. With the total volume of traded goods down and with novel trade opportunities emerging, shippers could gain real advantages from the diversification of shipping services. Just doing more of the same as in the past was not productive. In fact, often it was not even possible. The reorientation of many trades and the efforts to discover new ones to replace those diminished or lost gave shipbuilders reason to be concerned with innovation.

The starting point for any innovation was the ships already in use in 1300. Over the course of the late fourteenth and fifteenth centuries, shipbuilders generated a greater variety of vessels for the use of shippers and also for governments interested in naval power. Shipbuilders responded to the demand for new kinds of shipping services in three ways. First, they modified and improved what they had, in the process creating an evolution in the old designs. Second, they developed entirely new designs locally, departures from past practice. Third, they imported new construction methods from the South and modified those methods to suit their own skills and local needs. In time they exported or, in the case of designs brought in from southern Europe, reexported all those developments, in greater or lesser degree, to Iberia and to the Mediterranean. As a result, then, all Europeans, eventually, benefited from the accomplishments of the shipbuilders working on the shores of the North and Baltic Seas.

The dominant bulk carrier in northern waters had, since the twelfth century, been the cog. A product of the addition of a keel to an earlier Celtic coaster which bore the same name, this design was well established by 1350, and cogs could be found in most northern ports. The design evolved in the fourteenth century to generate an even more efficient vessel. Shipbuilders merged the cog design with that of the hulk, another type of Celtic ancestry and dating back to Roman or possibly pre-Roman times. Using the more rounded form, especially at the bow, of the hulk, shipbuilders produced a vessel which was easier to handle in the open sea and less likely to drift in a current or tide than the more square cog. On larger versions of the new merged type the bottom was not flat, or at least not as flat on the earlier versions of the cog. The new combined cog-hulk sacrificed little in carrying capacity relative to earlier cogs, so the better handling attributes were achieved at little cost.

3. For a balanced discussion of the problem of specie flows, see John H. A. Munro, "Bullion Flows and monetary contraction in late-medieval England and the Low Countries," in *Precious Metals in the Later Medieval and Early Modern Worlds*, John F. Richards, ed., (Durham, NC: Carolina Academic Press, 1983), 97-158.

The cog, as pictured on the second seal of the town of Elbing, around 1350. From Herbert Ewe, *Schiffe auf Siegeln* (Rostock: VEB Hinstorff Verlag, 1972), 122.

The more efficient bulk carrier that emerged by 1400 in ports like Gdańsk, where it appeared on the new town seal of that year, proved a great asset to grain farmers along the Baltic coast from Pomerania through Estonia. After the sharp drop in the number of mouths to feed in the wake of the Black Plague, those farmers were looking for outlets for what had suddenly become surplus production. Their interest in more efficient movement of their grain was greater because transport costs were about half of the delivered price of grain in the Low Countries, and because consumers in the Baltic needed to increase exports to pay for rising imports of relatively more expensive manufactures.[4] The simple solution of increasing the size of bulk carriers was out of the question. Larger ships would be hard to handle. More important, with a single sail the maximum size of a sail that the crew could raise fixed the maximum size of the ship. Even with the help of a capstan, usually fitted on a deck at the stern on cogs as well as on other types of single-masted sailing ships, there were physical limits on what the crew could do. There were also economic limits on how big the crew might get. Each man added for his muscle power to raise the sail was a mouth that had to be fed out of stores carried on board. Those stores reduced payload. The solution in the course of the fifteenth and particularly in the sixteenth century would be to divide the sail plan. Shipbuilders increased the number of sails while decreasing the size of each of the sails. The mainsail did not so much decrease in size, though there was some shrinkage, as the other sails grew. The greater division among the sails allowed a smaller crew to handle the same or more total canvas. The crew simply dealt with the canvas in smaller units. The superior sail plan also gave the captain greater ability to control his ship.

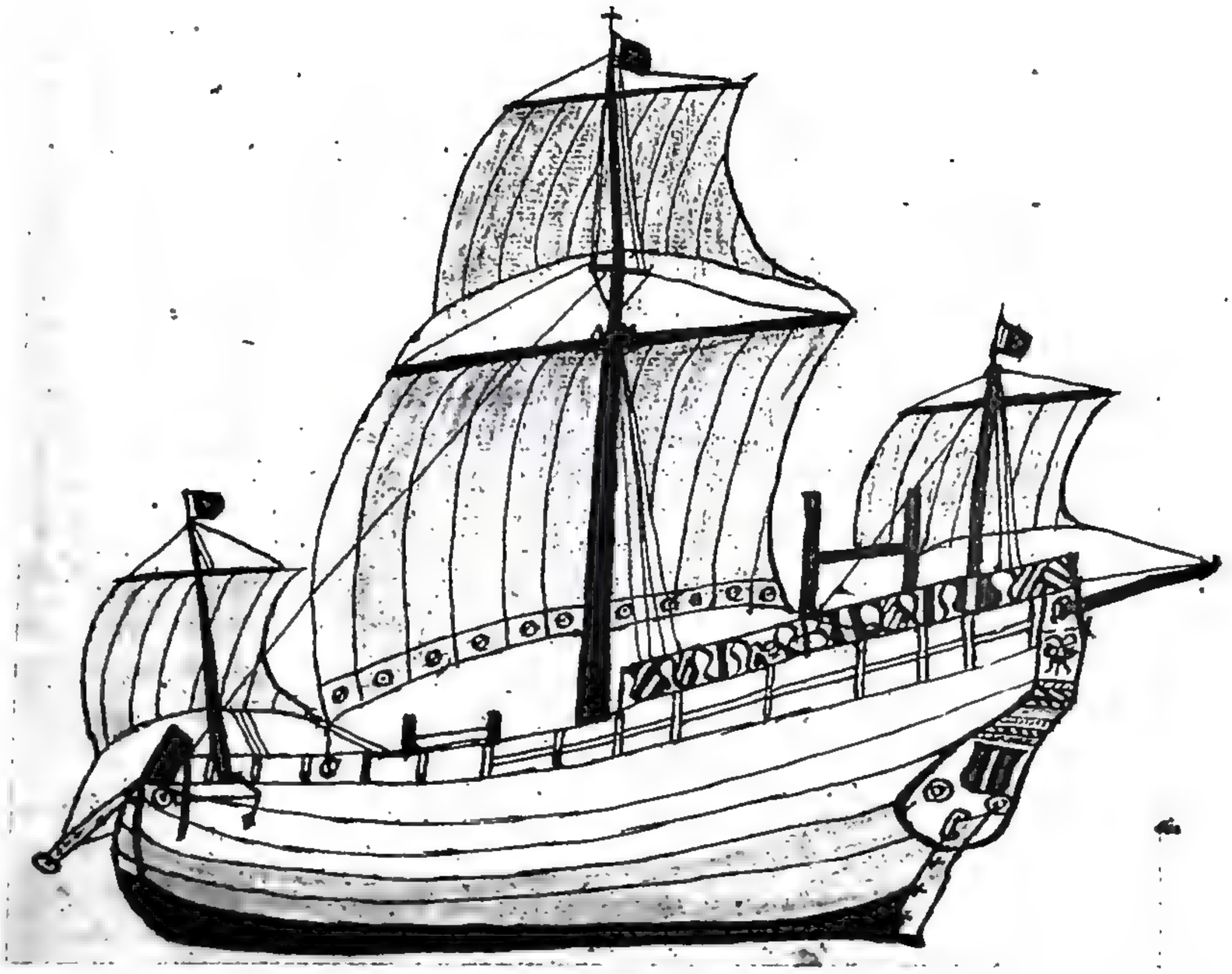
When northern European shipbuilders developed new designs locally, in almost every instance it was to meet some specific need. There was a number of different types of smaller vessels, such as the balinger and various types of barges, which combined sail and oar for propulsion.[5] They were popular for fighting and for amphibious operations and were used, for example, in the wars between England and France, but they also served to carry goods along the coast and as fishing vessels. Not all of the different types developed locally found only geographically limited use, though. One new type proved to be a major asset in the development of an industry which depended on technical advance and the changing consumption patterns in the wake of the Black Death.

The buss, which emerged in the course of the fifteenth century, was designed for use with large drag nets in the herring fishery. Novel methods of treating the fish at sea created a better and more accessible luxury foodstuff. The better and more abundant supply of cured herring met a rising demand, one created by falling grain prices which freed more of consumers' food budgets for things like fish.[6] The buss may have owed something to a high medieval Scandinavian design, a vessel called a *kongebuss*. In its late medieval form in the Low Countries the buss was long relative to its width, a ratio of 3 or 4 to 1, and carried three masts, each with a square sail. During fishing, two of those masts were struck. The fishermen set the sails and gear on racks on deck. The third stayed rigged and was used to keep some pressure on the long net. The combination of the new net, introduced in 1415, the superior method of treating fish, and the buss all created a thriving fishery and supplied a trade good for shipment along the coast of the North and Baltic Seas as well as the coast of France.

4. Richard W. Unger, *The Ship in the Medieval Economy, 600-1600* (London: Croom Helm, 1980), 163-171.

5. Smaller coastal vessels of all types have received little attention because of the difficulty of finding records of their use. For some suggestions on the importance of such vessels see J. W. Sherborne, "English Barges and Balingers in the Late Fourteenth Century," *The Mariner's Mirror* 63 (1977): 109-114.

6. Richard W. Unger, "The Netherlands Herring Fishery in the Late Middle Ages: The False Legend of William Beukels of Biervliet," *Viator* 9 (1978): 335-356.

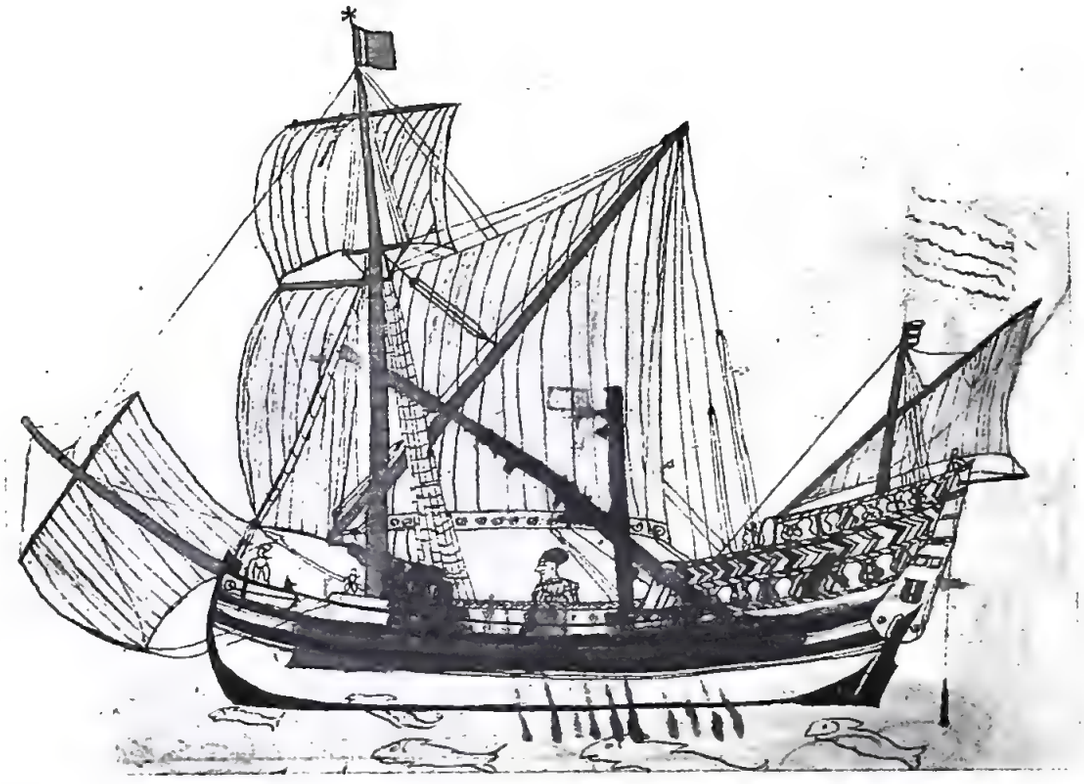


A herring buss from around 1570: Gemeente Archief Dordrecht, Archief der Gemeente Dordrecht, I, De Grafelijke Tijd, 1200-1572, X, Keur-en Handvestboeken, 12.

It was another new design, the boyer, which played a role in the more efficient distribution of goods such as fish but also more traditional trade goods such as grain. That type combined a relatively high length-to-beam ratio and a flat-bottom or modified flat-bottom and squared-off cross section with a novel rig. By the sixteenth century at the latest, the boyer had a spritsail, a forestaysail, a square main and maintopsail, and a lateen sail on a small mizzen mast. The somewhat complex, highly divided sail plan and the variety of sails allowed crews to be kept small with no loss of handling ability. Boyers required few men to handle them, registering figures as high as twenty tons served for each crew member. Since warships would have one crew member for each ton and bulk carriers would be very fortunate to have ten tons per crew member, the boyer was by standards of the day very efficient and well-suited to use on coastal and short distance trading voyages. At lengths of twenty meters or more by the late sixteenth century, boyers could carry sizeable quantities of goods at relatively low cost.[7]

Of greater importance to the development of ocean sailing for all of Europe, though, were designs brought in from the South, designs which were then adapted to local needs and local knowledge. Not all designs imported from the South succeeded. Galleys in general and the great galley — a Venetian cargo ship with three lateen-rigged masts and a large complement of rowers — never succeeded in finding a home in the North even though the type was known and used in northern waters. Venetian, and after them Florentine, shippers sent great galleys to Southampton and Antwerp for economic reasons. Those vessels brought north from the Mediterranean luxuries, including tropical and sub-tropical fruits, goods which needed rapid shipment to prevent spoilage. In return they took back high quality wool from England and Flanders, a necessary raw material for the luxury textile industries which developed in late fourteenth- and fifteenth-century Italy. Galleys, whether large trading galleys or naval vessels with a single deck, failed to gain anything more than a foothold in the North, primarily for technical reasons. The waters of the Atlantic and even the North Sea proved to be too rough for vessels with such low freeboard. To combat the rough seas, the answer was to raise the sides. But such an increase in height would either raise the angle at which oars entered the water, decreasing their effectiveness, or force builders to find some way of piercing the sides of the hull for the oars to pass through while keeping water from coming in those holes. Neither solution was satisfactory. Even in what was considered good weather in the North, rowers found it hard to move their galleys against the winds, tides, and generally rough waters. In the fifteenth

7. Unger, *The Ship in the Medieval Economy*, 262.



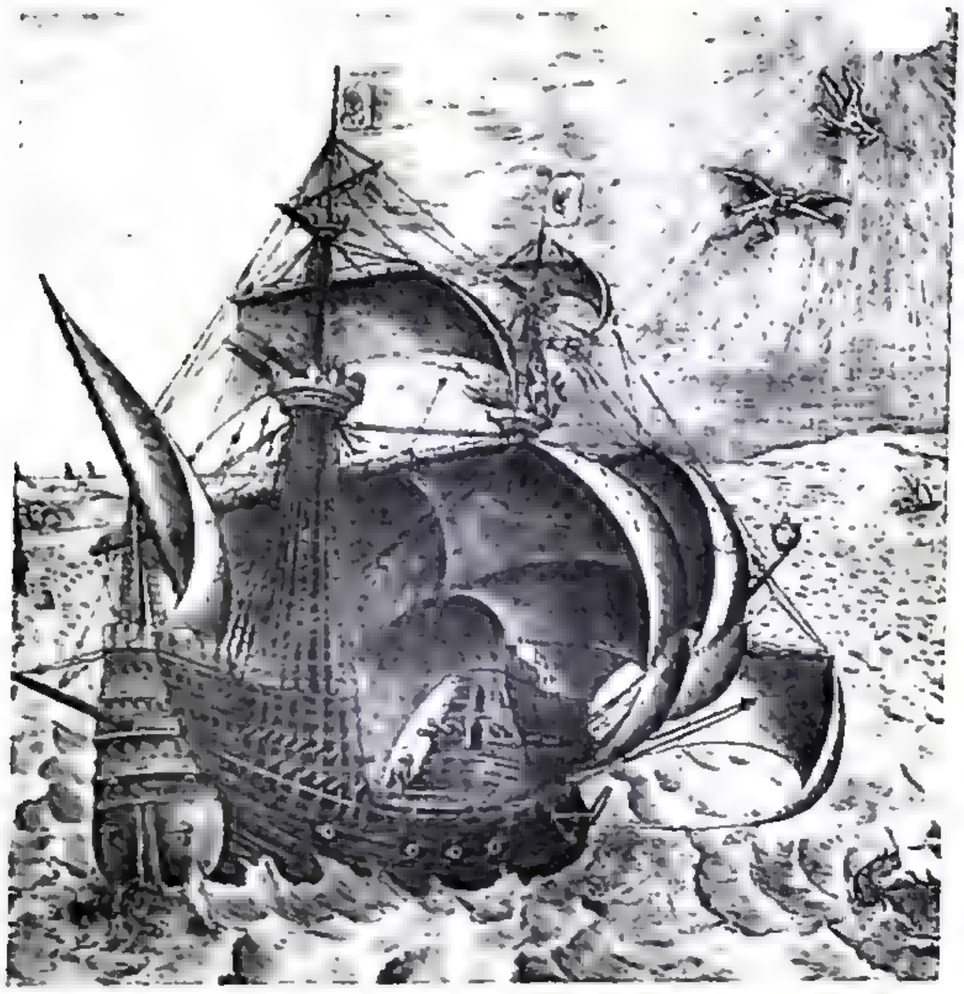
A boyer from about 1570. Gemeente Archief Dordrecht, Archief der Gemeente Dordrecht, I, De Grafelijke Tijd, 1200-1572, X, Keur-en Handvestboeken, 12.

century, Italian maritime republics found it more and more difficult to recruit rowers for galleys. Eventually the solution was to use convicts to row. In the more thinly populated North, with less of a tradition of oared vessels, finding men to man the oars must have been difficult; in fact, it seems to have been virtually impossible. The problems of propulsion, of manning, and of security of the vessels proved insurmountable, and other than a few government experiments with rowing barges for naval and ceremonial purposes, galleys were not adopted in northern Europe.

The full-rigged ship combined square-rigged main and foremasts with a mizzenmast carrying a lateen sail. That type first appeared around 1400. It was a modification and alteration of the northern cog made in the Mediterranean or along the Biscay coast of Spain or France. Sailors had taken the northern cog into the Mediterranean as early as the end of the twelfth century. Southern shipwrights made a range of changes in that cog and converted it into a carrack with two masts, one with a square sail and the second with a lateen sail. It was in that form, carrying bulky goods from the Mediterranean or archers to fight naval battles in the English Channel, that the modified cog came back to the North.

The biggest change Mediterranean shipbuilders had made in the cog was in hull construction. They replaced northern European clinker or lapstrake building with smooth-surface or carvel-building. The former, in having each plank fitted meticulously and precisely to the previous one partially overlapping it, created an extremely sturdy and durable vessel. The latter was a more flexible method of construction, strength coming from the internal framing. It had been in use in the Mediterranean since the end of the first millennium. The change in building made the cog easier to handle, simpler and less expensive to construct, and just as reliable if not more so. The first change in the rigging came with the addition of that second mast with a lateen sail. It did not take long to realize that a third mast, at the bow, would balance effectively the sail at the stern and make it easier to control the vessel. First in the form of the two-masted Genoese carrack and then in the form of the full-rigged version, northern European shippers and shipbuilders realized the commercial and naval advantages of the new type. They had in the bulk carriage of grain and in the movement of a variety of goods between Iberia and the Low Countries an economic use for the new carrack.

In order to produce the new type, though, shipwrights had to adopt an entirely new and unfamiliar building technique. It is clear that northern shipbuilders had troubles in taking on and developing the new method of construction. As late as the 1670s, a Dutch writer on shipbuilding was still copying a description of how to go about building in the skeleton-first way that

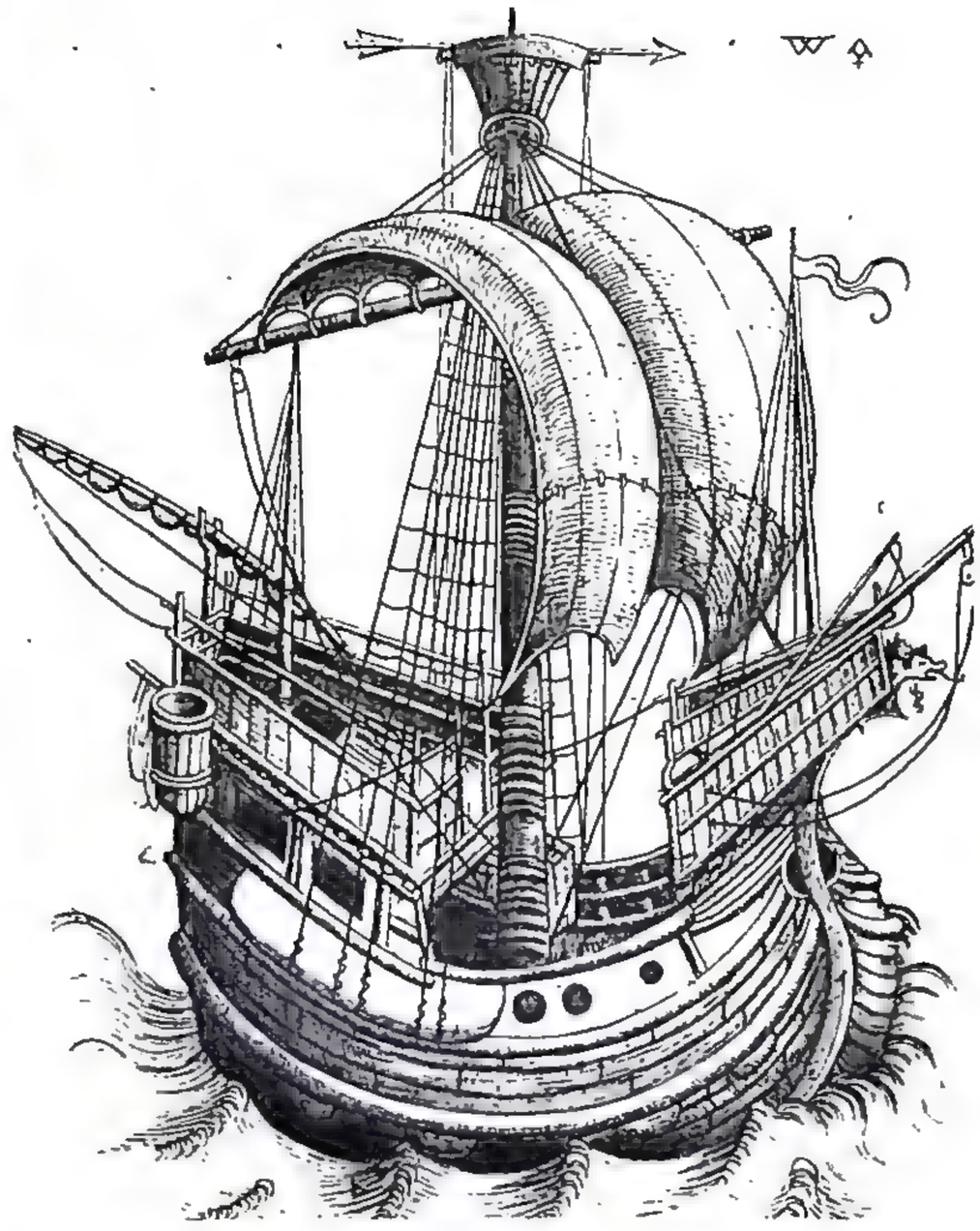


A full-rigged ship with divided sail plan under full sail, from *The Fall of Icarus* by Peter Breugel the Elder, mid-sixteenth century. From Rijksmusueum Nederlands Historisch Scheepvaart Museum, K 1215a.

had been written in Portugal a hundred years earlier.[8] In the 1430s in the Low Countries, the Duke of Burgundy had to bring in Portuguese shipwrights to build in the new style. In the province of Zeeland, at the town of Zierikzee where skeleton-building was first tried, it was a Breton shipbuilder who taught local men how to construct a ship in the new style. In the Baltic at Gdańsk in 1462, a 700-ton sample of the new type was deserted by its captain. With that example at hand, local shipwrights, but only over the following two decades, were able to imitate successfully the new type of shell-first building.[9] It was not so much the placing of planks end-to-end that bothered northern builders. They had done that on the flat bottoms of cogs for centuries. Rather it was probably having to set up the frames and the ribs first, that is, before putting on the hull planking, which was the greatest obstacle to innovation. The builder had to know exactly what the ship would look like when it was finished before construction started. He had to imagine all the implications of the shape of the ribs and, in fact, just the shape of the single central rib before he drew it and gave direction to the carpenters

8. Nicolaes Witsen, *Architectura Navalis et Regimen Nauticum ofte Aaloude en Hedendaagsche Scheeps-bouw en Bestier* (Amsterdam: Pieter en Joan Blaeu, 1690), 88-90; Walther Vogel, "Ein Neuentdecktes Lehrbuch der Navigation und des Schiffbaues aus der Mitte des 16. Jahrhunderts," *Hansisches Geschichtsblätter* 17 (1911): 370-374.

9. Unger, *The Ship in the Medieval Economy*, 220-223.



A smaller cargo ship, full-rigged, from northern Europe around 1470, engraved by WA. From Rijksmuseum Ned. Hist. Scheepvaart Museum, K 1244 6.

who would put them together. Shipbuilders in the Mediterranean had perfected that art over the previous half-millennium and more. It was some time before northern Europeans became adapted to the changed requirements of shipbuilding.

In this case as in others it appears that, rather than absorb immediately and completely a new technology, shipbuilders found a halfway house, adopting the technique only partially and in modified form. Such mixtures of techniques are a common feature of technical change and most particularly of shipbuilding.[10] As late as the eighteenth century, Dutch shipbuilders, known to be among the best in Europe, were still beginning the process of construction just the way their predecessors from the high Middle Ages had, but then going over to Mediterranean building. They started the hull by putting in place the first four or five or more planks on either side of the keel, and only when that process was finished did they design, make, and put in

10. See, for example, O. Hasslöf, "Main Principles in the Technology of Shipbuilding," *Ships and Shipyards, Sailors and Fishermen, Introduction to Maritime Ethnology*, O. Hasslöf, H. Henningsen and A. E. Christensen Jr., eds. (Copenhagen: Rosenkilde and Bagger, 1972), 27-72.

place the ribs. Mediterranean shipwrights, after setting up the keel and posts, went straight to forming and fixing the ribs. That radical change from the earlier practice of fitting each plank to the one below it, the traditional way of building using northern lapstrake construction, was obviously too much for Dutch shipbuilders. In the second half of the seventeenth century, when the French minister of finance J.-B. Colbert sent spies to England and Holland to find out about shipbuilding methods, he got reports of very different practices in the two countries. English builders followed the Mediterranean fashion, but Dutch builders used a modification of the traditional method, he was told. A Swedish writer on shipbuilding in 1691 illustrated two different kinds of construction, the Dutch method being different from the norm because shipbuilders put the first planks in place before setting up the ribs. The dogged retention of a then-outmoded technique showed not only the conservatism of shipbuilders, but also the ability to combine different traditions to the greatest advantage.[11] The products of those Dutch shipyards were not inferior to their English or their Mediterranean counterparts, but they were built differently. The hybrid method continued in use despite the recognition, as early as the fifteenth century, of the value of the design which came north in the form of the carrack.

Once mastered, or rather accommodated, the skeleton-first building method in the hands of northern Europeans led to the production of vessels of the highest quality. Northern ships might have lagged somewhat behind in complexity or in quality of their designs compared to their southern European counterparts in the fifteenth century, but by the mid-sixteenth century that was certainly no longer the case. Designs from the Baltic had formed the base for the development of the earliest ships of exploration. Portuguese barks that sailed down the coast of Africa and clawed their way back to Lisbon in the fourteenth century were probably just like Scandinavian ships of the period or even earlier. The vessels of Columbus and Vasco da Gama at the end of the fifteenth century owed their original form to the cog. Shipbuilders in northern Europe, through no choice of their own in the interchange of technical information, had contributed to the tools of reliable European long-distance ocean travel.

In northern Europe shipbuilding was better in 1492 than it was in 1300. That was true if for no other reason than it was more varied. The same can be said of southern Europe. There were more types of ships, with different hull forms and rigging, that were built in different ways. The economic changes of the late Middle Ages created greater potential for gain for merchants and for shippers, gain which could especially be found in long-distance trade. That certainly and most emphatically included trade between the two regions of the Continent. The interchange of all kinds — economic, political, personal — which resulted from those economic opportunities made technical knowledge more easily available along all the coasts of Europe from the eastern Mediterranean to the eastern Baltic. The greater variety of options known in part or in full to shipbuilders made northern Europeans, in turn, better able to exploit the opportunities which the economy presented to them in the fifteenth and even more so in the sixteenth century. The different types of ships available to shippers in northern waters by 1492 created more options and more efficient options, no matter if the designs were modifications of traditional, local ones or modifications and adaptations of ones brought in from the South. Northern Europeans, in part thanks to developments in the economy, also contributed to the development of ships capable of sailing to India and back and capable of sailing to America and back, and they produced such ships in large numbers very soon after Columbus returned from his first voyage. Furthermore, with their expanding range of ship types and nautical skills, northern Europeans also proved able to distribute quickly and economically the goods that came back from all those lands around the world, goods which improvements in ship design had added to the international trading network of Europe.

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11. Richard W. Unger, "Dutch Design Specialization and Building Methods in the Seventeenth Century," *Postmedieval Boat and Ship Archaeology*, ed. Carl Olof Cederlund (Oxford: British Archaeology Report, 1985), 153-164.

Columbus as Standardbearer and Mirror of the Spanish Reconquest

DONALD J. KAGAY

In an age of epic deconstruction as well as ethnic and generic tribalization, it is hardly surprising that an event as momentous as Columbus's sojourns of discovery to the New World has caused a variety of responses ranging from measured commemoration to outright vilification. Whether treated as the spearhead of a cruel domination which drained much of the Western Hemisphere's riches, or of an even more inhumane regime which hypocritically infected the Amerinds with both European religion and diseases, few recent authors have found Columbus worthy of praise or even moderate assessment.[1] Rather he is judged by a string of events which proceeded in one way or another from his four voyages like waves driven before a strong wind. Current interpretations of the Admiral of the Ocean Sea are tinged with an anachronistic view in which historical understanding is garbled by the application of modern value systems to situations long dead. To balance the record, one must review Columbus's life and career in light of a military and societal development which he adopted as his own and of which he eventually became a leader — that is, the Spanish reconquest.

If his "enterprise" had never come to fulfillment, one of the high points of Columbus's life would undoubtedly have been witnessing the end of Islamic Spain with the capitulation of Granada on 2 January 1492.[2] As the Catholic Kings received the keys to the beleaguered city from the last Muslim sovereign amidst the jubilant cheering of the Christian army, a militant *raison d'etre* unequalled in any other western European state had apparently come to an end for Christian Iberia. Since the first stunning Muslim raids into Visigothic Spain in 711, a militant frontier had stretched between the Christian and Muslim states of the peninsula. The rhythm of hostility between the two Spains, however, was far from regular. From the eighth to the eleventh century, the fledgling Christian realms along the uplands of the Pyrenees were subject to constant Muslim military pressure which occasionally erupted into massive invasions such as those brilliantly commanded by al-Mansur in the late tenth century.[3] With the disintegration of the Caliphate of Corduba into small principalities or *ta'ifas* in the first half of the eleventh century, the tables of conquest were turned and Muslim *Hispania* soon found itself at risk from the emergent realms of Castile, León, Catalonia, Aragon, and Portugal.[4] By the mid-thirteenth century, warrior kings such as James I of Aragon-Catalonia (1213-76) and Ferdinand III of Castile-Leon (1217-52) had conquered great swaths of Muslim land.[5] What was left to al-Andalus was a truncated Granadine kingdom caught between the threat of Christian annihilation or submission to fanatic coreligionists from North Africa who intermittently renewed war on the people of the Cross.[6]

Despite the potential for its delivery, the final Christian blow against Granada became less and less

1. For a distinctly negative view of Columbus and his impact on the Western Hemisphere in recent scholarship, see Kirkpatrick Sale, *The Conquest of Paradise* (New York, 1990) and Alfred Crosby, *Ecological Imperialism. The Biological Expansion of Europe, 900-1900* (Cambridge, 1984). For a more general and moderate treatment of the "Columbus Problem," see John Noble Wilford, *The Mysterious History of Columbus* (New York, 1991); Carla Rahn Phillips and William Phillips, *The Worlds of Christopher Columbus* (Cambridge, 1992); and Felipe Fernández-Armesto, *Columbus* (Oxford, 1991). Ultra-nationalistic and patriotic works on the discoverer are legion. Two examples are Peter Sammartino, *Columbus* (Whitestone, NY, 1987) and Anne Paolucci, *Cipango!* (Whitestone, NY, 1987).

2. Claudio Sanchez Albornoz, *La España musulmana*, 2 vols. (Buenos Aires, 1946, 1962); Townsend Miller, *The Castles and the Crown* (New York, 1964), 134; Miguel Angel Ladero Quesada, *Castilla y la conquista del reino de Granada* (Madrid, 1967), 16-17; Henry Kamen, *Spain, 1469-1714: A Society of Conflict* (London, 1980), 32-37.

3. Derek Lomax, *The Reconquest of Spain* (London, 1978), 46-7; W. Montgomery Watt and Pierre Cachia, *A History of Islamic Spain* (Edinburgh, 1965, 1977), 82-84.

4. David Wasserstein, *The Rise and Fall of the Party Kings* (Princeton, NJ, 1985), 55-811; Lomax, *Reconquest of Spain*, 49-51; Watt and Cachia, *History of Islamic Spain*, 84-91.

5. Joseph O'Callaghan, *A History of Medieval Spain* (Ithaca, NY, 1975), 340-57.

6. Watt and Cachia, *History of Islamic Spain*, 103-111; O'Callaghan, *History of Medieval Spain*, 219-222, 227-229, 336-341.

likely as the fourteenth century dawned. Far from girding their energies for a united thrust against the infidel, the Iberian Christians were drawn into conflicts against each other which were in time subsumed by the fire storm of the Hundred Years War.[7] Though Granada was a player in this peninsula-wide conflict, relations between Castile and Spanish Islam remained remarkably cordial. A cross-pollination of technical, economic, cultural, social, and even religious ideas existed across the frontier.[8] Even in political terms, the Muslim and Christian states were far from watertight compartments. One Castilian monarch, Henry IV (1454-74), surrounded by Moorish bodyguards and habitually dressed in eastern garb, seemed more of a Muslim than a Christian ruler.[9] As a frontier with the infidel became essential to the Castilian psyche, so a final conflict of extermination on the nonbeliever seemed unthinkable.[10] The resultant "phony war" — to use Second World War parlance — engendered two intellectual trends which underlay the Catholic Kings's bellicose mission against Granada and sustained Columbus in his journey to the Indies: chivalry and prophecy.

The frontier across Islamic and Christian Spain was a place of brutal reality and lavish imaginings. Despite its reluctance to engage in all-out warfare, a corner of the Castilian mind knew that "a divine predestination" impelled it to "cruelly expel" the infidel from Spain.[11] The Muslims, on the other hand, saw their fate long before it appeared before their walls. Conquest and expulsion was an inescapable fate, as they were hemmed in "between a violent sea and an enemy terrible in arms."[12] Desire to maintain military and political equilibrium across the frontier was thus understandable from the Muslim point of view, but Christians were surprisingly ambivalent on the same issue. At the core of this uncertainty was the lingering and, in fact, escalating influence of chivalry. Reaching an apex in the late thirteenth century, the tradition of the ideal knight in selfless service to lord and lady defined social status as much as did noble birth. This aspiration for a martial gentility came to be linked with the crusading movement and led authors such as the Catalan missionary and man of letters Ramon Lull to portray knights as agents of God whose strong arms were created "to vanquish the wicked who daily labor to destroy the Holy Church."[13] Even with the deleterious effect of the constant warfare of the fourteenth century which threatened every support of European civilization, "the nostalgia for a more beautiful life," to use Huizinga's words, assured the continuance of chivalric forms even after European societies began moving in directions which had little in common with knightly honor or courtly love.[14] Far from ossifying, tournaments, duels, and conventions of chivalric honor proliferated throughout the continent. It was as if Europeans were acting out their favorite reading matter, the chivalric romance and *chanson de geste*. Kings gathered valiant knights about them in orders of chivalry and, as latter-day Arthurs, charged their men to extend royal glory in peace and war. Sovereigns as late as Henry VIII of England (1509-47) took to the battlefield "not merely to equal but indeed to excel the glorious deeds of . . . [their] ancestors."[15] In Castile, the Islamic frontier provided a vast stage on which kings and nobles alike could play out and prove their chivalric correctness in one brilliant but useless campaign after another. Military objectives were less important than how such expeditions were carried out; defeats of the infidel were outweighed by the glittering nature of the foray itself.[16]

While such armed pageants could not be carried out without the Islamic protagonist, other forces in Castile looked past the honorable landscape of the "polite war" and visualized a total extermination of Muslim power in the peninsula. Some authors turned the controlled,

7. Manuel Sánchez Martinez, "Las relaciones de la Corona de Aragón con los Países musulmanes en la época de Pedro el Ceremonioso," in *Pere el Cerimoniós i la seva época* (Barcelona, 1989), 77-89; Desmond Seward, *The Hundred Years War. The English in France, 1337-1453* (New York, 1978), 106-107; O'Callaghan, *History of Medieval Spain*, 420-427.

8. J. N. Hillgarth, *The Spanish Kingdoms, 1250-1516*, 2 vols. (Oxford, 1978), 2: 315-316, 329-330, 369-371.

9. Townsend Miller, *Henry IV of Castile* (Philadelphia, 1972), 17; Angus MacKay, *Spain in the Middle Ages from Frontier to Empire* (New York, 1977), 204.

10. Hillgarth, *Spanish Kingdoms* 2: 202.

11. Ibid., 2: 367-368.

12. José Antonio Maravall, *El concepto de España en la edad media* (Madrid, 1964), 252.

13. Luis Suarez Fernandez, "The Kingdom of Castile in the Fifteenth Century," in *Spain in the Fifteenth Century, 1369-1516*, ed. Roger Highfield, trans. Frances M. Lopez-Morillas (New York, 1972), 106-107; Angus MacKay, "The Ballad and the Frontier in Late Medieval Castile," *Bulletin of Hispanic Studies* 53 (1976): 21-22; Maurice Keen, *Chivalry* (New Haven, CT, 1984), 64-83; Raymond Lull, *The Book on the Order of Chivalry* in *The History of Feudalism*, ed. David Herlihy (New York, 1970), ch. 3, esp. 313.

14. Johan Huizinga, *The Waning of the Middle Ages* (New York, 1924, 1956), 68-69. According to Huizinga, the best indication of chivalry's power is provided by the fiction of the later Middle Ages in which history "was reduced to a spectacle of the honor of princes and the virtue of knights, to a noble game with edifying and heroic rules."

15. Arthur B. Ferguson, *The Indian Summer of English Chivalry. Studies in the Decline and Transformation of Chivalric Idealism* (Durham, NC, 1960), 6-7, 13-14, 28-29, 159-160, 177, and *The Chivalric Tradition in Renaissance England* (Washington, D.C., 1986), 20-21.

16. MacKay, "The Ballad and the Frontier," 18.

almost theatrical chivalry on its head and argued that if limited glory was to be attained by confined wars with Islam, much greater fame would be gained through a total war against the same adversary. In 1463, the *converso* poet Juan de Luçena, dedicating a *copla* to his patron Henry IV, proclaimed:

> How glorious would be the King, how famous his vassals, how great the Crown of Spain . . . if the knights with the king were to march on Granada and . . . burst into Africa![17]

The terminology of such thinking was a mixture of chivalric, crusader, and prophetic cant. As one Italian observer remarked, "an implacable war on Spanish Islam" would call out all of Castile's "men of prowess who would have sooner lost [their] lives a thousand times than return dishonored to . . . [their] ladyloves."[18] This image of all Spanish chivalry united in a holy cause was reinforced by papal efforts of the fifteenth century to see the reconquest of Iberia completed.[19] Prophecy also lent an inexorable air to the perception of the *reconquista.* Adepts of the twelfth-century Franciscan mystic Joaquim de Fiore viewed the victory over Islam as one in a long line of events which would crown a last world ruler whose strong arm would defeat the infidel and regain Jerusalem for Christianity. This last monarch, whom many assumed would be Spanish, would then be overthrown by the anti-Christ whose advent signaled the end of the world.[20] These, then, were the parameters of Spanish imagination and aspiration which Columbus wedded to his own in the completion of the *empresa de las Indias.*

As an actual participant in the Christian siege of the Granadine fortress of Baza in 1489, Columbus knew the Spanish reconquest firsthand and came to epitomize the movement by both his achieved and unfulfilled aims. Like the war on Islam to which he had linked his energies, the Admiral lived on a faith which never deserted him and, in time, turned fantasy into fact. When such realities did not square with the beliefs he carried with him into the unknown, Columbus warped what he observed to fit the shape of what he "knew." He thus lived in a mirage of his own making which could be explained only by a core of certainties set in place long before he sighted the New World.[21]

The first of these "fixed stars" in the Admiral's psychological universe was a thirst for and acceptance of everything represented by the status of nobility. Though receiving advancement in rank only when the Catholic Kings adopted his "enterprise," Columbus had long felt an almost unworldly spirit of chivalry and adventure which percolated through all Iberian societies of the fifteenth century. In Portugal, where he lingered from 1477 to 1485 trying to gain support for his mission, the legacy of Prince Henry the Navigator (1394-1460) — a royal patronage of exploration as much for chivalric as for economic aggrandizement — lived on.[22] The Lusitanian drive down the West African coast, though a rich source of plunder and trade, remained for the Navigator and his countrymen an arena for the performing of "great deeds" *("grandes feitos")* in the waging of "honorable" war against the infidel.[23] This crusading zeal was even more deeply impressed on the adventurer when he came to Spain and made the crusade his own. When the Admiral effectively stepped to the fore of this movement and led it across the Ocean Sea, he relied on a courtly consensus which presaged the attitudes and many of the actions he took on his first journey. Below the intellectual superstructure of geographical "fact" which Columbus had assembled from Greek and Roman authors, the Old Testament, and the modern works of Bacon, D'Ailly, and Toscanelli,[24] there rested a mentality of chivalry stretched to the task of holy war with the unbeliever. In his journals and dispatches, the Admiral speaks fluently in the romantic parlance of his day. Though capable of keen observation of landscape, plants, animals, and people, he increasingly turned to a verbal palette drawn from such popular works of romantic fiction as *Amadis of Gaul* and *Tirant Lo Blanc* both to convey the exotic nature of what he saw and to inflate the greatness of his discoveries for

17. Roger Boase, *The Troubadour Revival. A Study of Social Change and Tradition in Late Medieval Spain* (London, 1978), 112.

18. Ibid., 114-115.

19. Hillgarth, *Spanish Kingdoms* 2: 203.

20. Delno C. West and August Kling, trans., *Libro de las profecias* (Gainesville, FL, 1991), 33-35; Marjorie Reeves, *The Influence of Prophecy in the Later Middle Ages* (Oxford, 1969), 359; Abbas Hamdani, "Columbus and the Recovery of Jerusalem," *Journal of the American Oriental Society* 99, no. 1 (1979): 41-42.

21. Edmundo O'Gorman, *The Invention of America. An Inquiry into the Historical Nature of the New World and the Meaning of its History* (Bloomington, IN, 1961), 78-80.

22. A. H. de Oliveira Marques, *History of Portugal,* 2 vols. (New York, 1972), 143-158.

23. Felipe Fernandez-Armesto, *Before Columbus. Exploration and Colonization from the Mediterranean to the Atlantic, 1229-1492* (Philadelphia, 1987), 186-187.

24. For geographical knowledge Columbus could claim before his explorations, see Samuel Eliot Morison, *Admiral of the Ocean Sea. A Life of Christopher Columbus* (Boston, 1942), 54-78, and Morison, trans., *Journals and Other Documents on the Life and Voyages of Christopher Columbus* (New York, 1963), 15-16; David B. Quinn, *North American Discovery Circa 1000-1612,* 2 vols. (Columbia, SC, 1971), vol.1, docs. 39, 41, pp. 83-84; G. E. Nunn, *Geographical Conceptions of Columbus* (New York, 1924).

those who read his words.[25] From some of the descriptions of his later expeditions, one almost sees the explorer as a kind of neo-Amadis trekking across one strange and florid landscape after another. This pall of otherworldliness deepens when the Admiral's religious and prophetic roles are investigated.

The transmutation of the Spanish reconquest into a crucial phase of transatlantic exploration was a development that many Iberians saw intertwined with their national military destiny, for as Gómara would say in 1540, "Spaniards always fight against infidels."[26] As architect of a vast new opportunity for Hispanic arms, Columbus saw both himself and Spain as chosen for a special commission. Though happily acknowledging his importance in the advancement of geographical certitude as well as the political position of his adopted country, the explorer ultimately judged his feats from an eschatological point of view. He could scarcely qualify as a *servus Dei*, a man of religious selflessness, but rather claimed to be a conduit of the Almighty's immanent purpose.[27] This unshakable belief in his place as a divine counter came to Columbus not after a career of asceticism and meditation but rather from his geographical researches. Compiling a corpus of information from the standard fonts of knowledge of his day, the Admiral, like Seneca, concluded that the "ocean . . . [would] break its bounds and a vast world [would] appear." Such an event could only be perceived as a portent of the end of time.[28] Once he found the gilded territories of the Indies, Spain would use their wealth to see the final defeat of and conversion of the infidel and reconquest of Jerusalem.[29] Rather than qualifying as a bona fide prophet through whom God spoke, the Admiral was an interpreter of earlier prophetical messages which he consciously attempted to fulfill. In the end, we must call Columbus an "activist visionary" who saw prophecy very much as he did geographical knowledge — they both gave him a plan to follow, the following of which made real what had been prophesied. In this way, points of cosmological certainty fused with those of a prophecy, and the Admiral configured the Indies as he had divined them to be. The worlds of the palpable and the spirit that Columbus discovered were therefore very much the same thing. On his third journey, when he encountered the mouth of the Orinoco River flowing into the sea from a great land which proved to be Venezuela, the Admiral, after weighing the "evidence" he knew to be true and that presented to his eyes, concluded that he had reached the Terrestrial Paradise described in *Book of Genesis*.[30]

Even the way Columbus interacted with the peoples of the New World was consistent with his *personae* as crusader, doer of great deeds, and fulfiller of prophecies. As a "bearer of Christ" *("Christum ferens")*, he was also a disseminator of the faith whose role was legally constituted by the patents he bore from the Catholic Kings.[31] As a "messenger of God" who held "the keys . . . to the Ocean Sea," Columbus felt ordained as the ultimate missionary of the faith. As another Marco Polo or Amadis, he expected to gain glory and wealth from his voyages and those he met on them.[32] What he found instead of the great Oriental civilizations which bordered the Indian Ocean were simple Caribbean societies which looked on the invaders as men from the heavens.[33] The tragic consequences of the interaction between Amerind cultures and these European demigods are well documented, but can all of these trends of oppression and infection be traced back to Columbus and the

25. A. D. Deyermond, "The Middle Ages," in *A Literary History of Spain* (London, 1971), 159; Ramon Iglesia, *Columbus, Cortés, and Other Essays*, trans. and ed. Lesley Byrd Simpson (Berkeley, 1969), 20-21; Oliver Dunn and James E. Kelley, Jr., trans., *The* Diario *of Christopher Columbus's First Voyage to America* (Norman, OK, 1989), 101, 105.

26. Marcel Bataillon, "The Idea of the Discovery of America among the Spaniards of the Sixteenth Century," in Highfield, ed., *Spain in the Fifteenth Century*, 452-453.

27. Iglesia, *Columbus, Cortés, and Other Essays*, 26-27; *Libro de las profecias*, 46.

28. J. S. Cummins, "Christopher Columbus: Crusader, Visionary, and *Servus Dei*," in *Medieval Hispanic Studies Presented to Rita Hamilton*, ed. A. D. Deyermond (London, 1976), 49.

29. Hamdani, "Columbus and the Recovery of Jerusalem," 43; *Libro de las profecias*, 29-30, 41, 66-69, 157; Pauline Moffitt Watts, "Prophecy and Discovery: On the Spiritual Origins of Christopher Columbus's 'Enterprise of the Indies'," *American Historical Review* 90 (1985): 88; Reeves, *Influence of Prophecy*, 360.

30. E. G. R. Taylor, "Idée-Fixe: The Mind of Christopher Columbus," *Hispanic-American Historical Review* 11 (1931): 88; Reeves, *Influence of Prophecy*, 360.

31. For the significance of Columbus's epigram,

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see West and Kling, *Libro de las profecias*, 72-73. For the text of Columbus's office bestowed by the Spanish Crown in 1492, see Antonio de la Torre, ed., *Documentos sobre relaciones internacionales de los reyes catolicos*, 6 vols. (Barcelona, 1951-62), vol. 4, doc. 49, pp. 34-37.

32. Cummins, "Christopher Columbus," 49; Iglesia, *Columbus, Cortés, and Other Essays*, 28. The diplomatic papers Columbus carried and a passage from the diary of his first voyage indicate that the Admiral hoped to attain all of his goals as an envoy to the Great Khan, the Mongol conqueror of China. See Torre, *Documentos*, vol. 4, doc. 58, pp. 41-42; Dunn and Kelley, *Diario*, 18-19; Cristobal Colón, *Textos y documentos completos. Relaciones de viajes, cartas, y memoriales*, ed. Consuelo Varela (1982; Madrid, 1984), 15-16.

33. Martin Fernandez de Navarrete, *Obras*, 3 vols., nos. 75-77 of *Biblioteca de autores españoles desde la formación del lenguaje hasta nuestros dias* (Madrid, 1954), 1: 97.

pattern of race relations he established? In truth, the Admiral's view of the people he met was a preconceived though ambivalent one. As a follower of Marco Polo, he treated every new island he came upon as a possible site of the glittering Asian cultures he "knew" had to exist in that quadrant of the globe. He served as Spanish ambassador to the Great Khan, the Mongol Emperor of China, even though there had not been a Great Khan in China since 1368. As a diplomat to an empire which existed only in his head, then, Columbus's approach to the Indians was a formal one, not unlike that of Christian and Muslim parties during truce phases of the reconquista.[34] While the newcomers initially treated the natives as subjects of the Great Khan, their outlook toward the aborigines was couched in the language of mythic social theories of their day. The motif of a golden age uncluttered by modern culture was a dominant theme in Columbus's description of the Indians. Many of these "gentle" natives were for the Admiral at a level of Edenic simplicity. On the other hand, some of the people he found or heard of confirmed the existence in the New World of exotic men of faintly anthropomorphic nature who practiced cannibalism on friend and foe alike. Europe had long assumed that such "wild men" *("homines silvestri")* lived beyond the pale of civilization but had only encountered such creatures in the realms of imagination.[35] Thus, Columbus's perception of the peoples he met was couched in the Hispano-Muslim world he knew and the Oriental universe he imagined.

If the initial European response to the Indians was couched in fantasy and myth, a brutal, inhuman line of manipulation and domination soon followed. The forced conversion *(requirimiento)* and the practice of putting Indian work gangs at the disposal of the colonists *(encomienda)* were forms which began to surface in the latter stages of the reconquest and in Iberian colonization of the Canary Islands; none of the barbarities which soon overwhelmed the Amerind societies can be laid fully at Columbus's feet.[36] The Admiral was at times quite magnanimous and judicious in regard to the Indians, often ordering that "they be honored and reassured to keep them from taking offense." Such a paternal stance was hardly consistent with a reconquest ethnocentrism which ranged people in order of worth by religion and race. The idea that the Indians bore their subservience as a birthright was not a new concept but one which harkened back to reconquest dominance of Muslims and Jews by Christians. Columbus simply encouraged this Iberian subjugation of whole Indian nations by judging the original inhabitants of the New World more as commodities than as human beings.[37]

Like any reconquest lord, Columbus equated the aborigines (like the infidels) with the profit they represented. The New World thus seems to fill the role once played by Muslim Spain — a source of ready gold for the Christians to take or extort. This thirst for gold had already sounded a keynote in earlier Spanish and Portuguese overseas ventures and would remain a consistent factor as long as Iberian domination of the New World endured.[38] A simple case of "gold fever" does not explain the Admiral's attitude toward the precious mineral and the thousands of Indian lives squandered to mine it. Like the other impoverished Spaniards who followed him, Columbus showed a brutal greed which seemed to possess him at times. Unlike his compatriots, he saw gold as a ready means for financing further expeditions to and founding colonies in the Indies. Discovering the metal in great quantity would declare to the world and to himself that success had finally come to his life. With this golden endowment, the Spanish king could finally defeat the infidel and regain Jerusalem. Eventually the precious windfall of the New World had a religious symbolism for Columbus because with it "many souls could be brought to Paradise."[39] When this prize was denied him, the Admiral concluded that his mission was a failure and that the Almighty had deigned it so. True to his character, he blamed everyone but himself for this defeat of limitless proportions. [40]

Whether Columbus's downfall may be attributed to the vengeance of a divinity more at home in the Old

34. Dunn and Kelley, *Diario*, 127-9; Varela, *Textos y documentos*, 48-9; Robert I. Burns, SJ, *Muslims, Christians, and Jews in the Crusader Kingdom of Valencia* (Cambridge, 1984), 52-79.

35. Stanley L. Robe, "Wild Men and Spain's Brave New World," in *The Wild Man Within. An Image in Western Thought from the Renaissance to Romanticism*, ed. Edward Dudley and Maxmillian E. Novak (Pittsburgh, 1972), 44-45; Dunn and Kelley, *Diario*, 274; Varela, *Textos y documentos*, 95.

36. Felipe Fernández-Armesto, *The Canary Islands after the Conquest. The Making of a Colonial Society in the Early Sixteenth Century* (Oxford, 1982), 125-126; Charles Verlinden, "Medieval Slavery in Europe and Colonial Slavery in America," in *The Beginnings of Modern Colonization* (Ithaca, NY, 1972), 41; Lesley Byrd Simpson, *The Encomienda in New Spain* (Berkeley, 1966), 9-10, 22-23; Silvio Zavala, *New Viewpoints on American Colonization* (Philadelphia, 1973), 27.

37. Iglesia, *Columbus, Cortés, and Other Essays*, 18, 24-25.

38. *Libro de las profecias*, 69; Leonardo Olschki, "What Columbus Saw on Landing in the West Indies," *Proceedings of the American Philosophical Society* 84 (1941): 655; Carl Ortwin Sauer, *The Early Spanish Main* (Berkeley, 1969), 31.

39. Cummins, "Christopher Columbus," 47; Hamdani, "Columbus and the Recovery of Jerusalem," 44.

40. Sauer, *Early Spanish Main*, 98. Columbus concluded that "God Our Lord . . . concealed the gold from us" because of the lascivious and greedy nature of the first American settlers.

Testament than the New World or his own weak mismanagement of the American situation, he became an increasingly hollow man as he moved into old age and the ideological props of his character were successively toppled. When almost drowned in a hurricane on his fourth voyage in 1503, the master mariner climbed to the top of his ship's mast and called out for help from his former allies, the Catholic Kings, and the four winds, "but they answered nothing to me."[41] This disconsolate Job-of-a-man rails against a tumultuous reality which threatened to overwhelm a thought-world in which he played creator. His certainties had begun to crumble some years before in 1500, when his governorship was rescinded and he was sent to Spain in chains. He complained bitterly that his record was judged as if he were the governor of some peaceful province rather than "a captain who went from Spain to the Indies to conquer people numerous and warlike."[42] This assault on his power was rooted in the dual nature of his prerogatives granted in the *Capitulations of Santa Fe* in 1492. As Admiral, Columbus had all but absolute power in outfitting, manning, and summoning royal fleets to explore the Ocean Sea. As Viceroy, he was to act as a royal deputy in appointing mayors and aldermen in the islands he found and in governing these lands "according to the custom of the other viceroys and governors of Their Majesties." The first title was much less unfettered, since in matters naval he answered to no one but his sovereigns. Viceregal power involved the much more complex task of setting up a government or maintaining one already in existence. As such, the Viceroy was hemmed in on all fronts by the rights and privileges of those he ruled as well as by the norms of a royal bureaucracy.[43] Despite the uneven nature of his offices, Columbus's wholehearted attachment to his divine mission made him extremely ineffective as an administrator. Visionaries make good explorers but terrible governors. His pettiness and venality did not help the situation, nor did the fact that the earliest crewmen and settlers who accompanied him came from a Castilian underclass which had escaped the confines of prison or poverty to risk the dangers of the Ocean Sea.[44] Columbus's failure is that of the reconquest itself. Like many another frontier figure, he was carried far by the momentum of a movement which he made his own. The dynamics of a quest for terrestrial and paradisial ends validated his entire life. Yet settlement always follows exploration, and even the first signs of a stasis marked by an administrative regularization of Spain's transatlantic lands spelled the effective end of the Admiral's career as forerunner of the *reconquista*.

The Admiral spent his last years cavilling about the rights and dues of which he claimed he had been swindled by a greedy Spanish Crown and its deputies.[45] With his death in 1506 and the subsequent conquests by the likes of Cortés and Pizarro, the world of *conquistador* rapidly gave way to that of the *letrado*, the university man who fashioned and staffed the colonial administration, and the *peón*, the settler who brought the New World under cultivation. The reconquest and its overseas extension were complete. Columbus must have seen that as his days dwindled away, his *empresa* could never be achieved as he envisioned it. He mourned the passing of a reconquest universe of ideal proportions and, like the grandfather in Steinbeck's *The Red Pony*, surely bemoaned the fact that there was no place left for him and the world which had made him, since:

> Westerning has died out of the people. . . . Westerning isn't a hunger anymore. It's all done.[46]

41. Cummins, "Christopher Columbus," 52.

42. Navarrete, *Obras* 1: 22; Morison, *Journals and Other Documents*, 296; Varlea, *Textos y documentos*, 269-270.

43. Navarrete, *Obras* 1: 263, 276; Angel de Altoguirre y Duvale, "Estudio jurídico de las capitulaciones y privilegios de Cristobal Colón," *Boletin de real academia de história* 38 (1901): 283, 288-289; Juan Manzano Manzano, "La adquisición de las Indias por los reyes castellanos," *Anuario de história del derecho* 31 (1951): 87-88; Alfonso Garcia-Gallo, "Los virreinatos americanos bajo los reyes catolicos. Planteamiento para su estudio," *Pensameinto politico, policia internacional, y religiosa de Fernando el Catolico* (Zaragoza, 1956), 153-156; Charles E. Newell, "Old World Origins of the Spanish-American Viceregal System," in *First Images of America. The Impact of the New World on the Old*, ed. Fredi Chiapelli, Michael T. B. Allen, and Robert L. Benson, 2 vols. (Berkeley, 1975), 1: 222-225.

44. John Fraser Ramsey, *Spain: The Rise of the First World Power* (University of Alabama, 1973), 240.

45. Navarrete, *Obras* 1: 394-395; Sauer, *Early Spanish Main*, 101-102, 107, 191; *Colección de documentos para la história de Costa Rica relativos al cuarto y ultimo viaje de Cristobal Colón* (San José, Costa Rica, 1952), doc. 48, p. 87. For subsequent Columbus family lawsuits, see William Giles Nash, *America, the True History of its Discovery* (London, 1924), 59-172.

46. John Steinbeck, *The Red Pony* (New York, 1945), 91.

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Columbus and European Views of the World

WILLIAM D. PHILLIPS, JR.

In 1501-02, Christopher Columbus was in Seville, awaiting permission for a fourth transatlantic voyage. It was a low period in his life. In 1500, a royal inspector had arrested him in Santo Domingo on Española and sent him home in chains, charged with gross failure to fulfill his pledges of good colonial government. After he reached Spain, Fernando and Isabel quickly loosed his chains and dropped the charges against him, but they delayed in granting him permission for a fourth voyage. What the Admiral did during those years of waiting allows us to see the relation of his views to European views of the world at the end of the fifteenth century and the beginning of the sixteenth.[1]

During the period between the third voyage and the fourth, as Columbus sought to regain royal favor, he worked on two important compilations of documents. He would use both of them to justify his actions and sustain his legal and moral claims to primacy in the development of the Indies. The first was his *Book of Privileges*, a notarized collection of royal agreements, orders, and letters bearing on Columbus's relations with the crown. With his hard-won royal concessions in jeopardy, Columbus needed a complete and authoritative documentary base for the litigation that almost surely would follow. He enlisted notaries in Seville to make a complete set of the documents; when they were finished, he sent two copies to Genoa and a third to the Carthusian monastary of Santa María de las Cuevas near Seville.[2]

One of the monks at Las Cuevas collaborated with Columbus on the other important compilation he produced during that period. The monk was Gaspar de Gorricio, and the compilation was the *Book of Prophecies*. In it Columbus assembled a collection of biblical passages, writings of church fathers, and the work of geographical writers such as Pierre d'Ailly. The passages chosen are an eclectic mixture indeed, apparently selected for their presumed relevance to Columbus's discoveries, the need to take Christianity to all parts of the world, and the reconquest of Jerusalem. The *Book of Prophecies* reveals Columbus's increasing preoccupation with apocalyptical speculation.[3]

As a preface to the *Book of Prophecies*, Columbus placed a letter to the Spanish monarchs, telling them the reasons for his belief that God had chosen him specially for the discoveries he made. Intended to regain his monarch's favor, the letter offered a description of his intellectual preparation for his westward voyage to Asia. The letter is undoubtedly an accurate depiction of what Columbus believed in 1501 and 1502, but it is impossible to say whether it truly reflects what he believed before 1492. Nonetheless, it shows a large part of Columbus's understanding of the European views of the world in his day.

> Most eminent rulers: At a very early age I began to navigate upon the seas, which I have continued to this day. Mine is a calling that inclines those who pursue it to desire to understand the world's secrets. Such has been my interest for more than forty years [he was about fifty when he wrote those words], and I have sailed all that can be sailed in our day [at least by Christian Europeans]. I have had business and conversation with learned men among both laity and clergy, Latins and Greeks, Jews and Moslems, and many others of different religions. I prayed to the most merciful Lord concerning my desire, and he gave me the spirit and the intelligence for it. He gave me abundant skill in the mariner's arts, and adequate understanding of the stars, and of geometry and arithmetic. He gave me the mental capacity and the manual skill to draft spherical maps, and to draw the cities, rivers, mountains, islands and ports, all in their proper places.
>
> During this time, I have searched out and

1. For a full account of the life of Columbus and the contexts into which it fit, see William D. Phillips, Jr. and Carla Rahn Phillips, *The Worlds of Christopher Columbus* (Cambridge: Cambridge University Press, 1992).

2. Helen Nader is translating and editing the *Book of Privileges*, due to appear shortly as part of the *Repertorium Columbianum*, published by the University of California Press.

3. *The* Libro de las Profecías *of Christopher Columbus: An* en face *edition*, trans. and commentary by Delno C. West and August Kling (Gainesville: University of Florida Press, 1991).

> studied all kinds of texts: geographies, histories, chronologies, philosophies and other subjects. With a hand that could be felt, the Lord opened my mind to the fact that it would be possible to sail from here to the Indies, and he opened my will to accomplish the project. This was the fire that burned within me when I came to visit Your Highnesses. All who found out about my project denounced it with laughter and ridiculed me. All the learned opinions were no help. Only Your Majesties had faith and perseverance. Who can doubt that this fire was not merely mine, but also of the Holy Spirit who encouraged me with a radiance of marvelous illumination from his sacred Holy Scriptures, by a most clear and powerful testimony from the forty-four books of the Old Testament, and from the four Gospels, from the twenty-three Epistles of the blessed Apostles — urging me to press forward? Continually, without a moment's hesitation, the Scriptures urge me to press forward with great haste.[4]

The letter goes on to relate Columbus's belief in the late medieval millenarian and apocalyptic tradition that called for a relatively quick end to the world. Columbus himself figured the end coming in 150 years. He reported that he had already played a role in preparing the ground for the necessary conditions for the end of time. He had carried the Christian message to people previously unexposed to it. A further necessary condition was the Christian reconquest of Jerusalem. He intended to use the profits from his ventures to accomplish that goal.

Beyond that, the letter presents a partial account of the genesis of his plans. Characteristically for Columbus, it also stressed divine support, implying to the Spanish monarchs that if God were on his side, could they afford not to be? Columbus certainly used biblical evidence as he built his project and as he sought to develop it afterwards. His ideas about the size of the world and the way to the Asian wonderlands of Cipango and Cathay probably did not develop all at once. It seems likely that they evolved in a piecemeal fashion. In the biography of Columbus attributed to his son Hernando, the origins of Columbus's geographical ideas are described as "natural reasons, the authority of writers, and the testimony of sailors,"[5] putting Columbus's reasoning ability and scholarship ahead of mere hearsay.

The biography consistently embellishes all aspects of Columbus's life to make him appear learned and cultured, which would suit his son Hernando, himself a cultured and wealthy intellectual. In reality, Columbus probably read and selected from important writers later rather than sooner, perhaps even after he went to Spain, when he had already settled on his plan and was attempting to bolster its credibility.

Thus, Columbus used a variety of sources to prepare his plan and to justify it to himself and to potential backers, and his schemes and explanations fit closely within contemporary European views of the world. There were three components of Columbus's world view: first, the practical knowledge that he gained from his own voyages and from the stories and rumors he collected; second, his extensive reading in secular and religious sources; and, third, his use of cartography.

The first and most important knowledge came to Columbus from his own direct experience, particularly from his voyages. As he wrote in 1501: ". . . from a very early age I went to sea sailing and I have continued it until now."[6] Genoese merchants had created a number of commercial enclaves on the Mediterranean and Atlantic coasts, and it was not difficult for a young Genoese to ship out on one of the many trading voyages they sponsored. At first, Columbus probably sailed on short voyages close to Genoa. We know from his own writing that he also went on a longer voyage to Chios, an island in the Aegean then held by the Genoese. Chios served as an entrepot for trade in the eastern Mediterranean, and gum mastic was the island's main product of commercial importance. On his first voyage across the Atlantic, Columbus would claim that he had previously seen "all the east and west" ("todo el levante y poniente"), and it is likely that his voyage to Chios lay behind this claim.[7] Although he was clearly stretching the point, Chios could be considered the east or Levant, especially given its connections to Constantinople and Asia Minor.

Other adventures from Columbus's early days at sea have even more exotic connotations. Hernando Colón provided a quotation from his father that many scholars have found hard to credit. In a fragment of a letter that Columbus supposedly wrote to the Catholic Monarchs from the island of Española in January of 1495, he said:

> It happened to me that King René (whom God has taken) sent me to Tunis to capture the galleass *Fernandina;* and when I was off the island of San

4. West and Kling, *Libro de las profecías*, 110-11.

5. Ferdinand Columbus, *The Life of the Admiral Christopher Columbus by his Son Ferdinand*, trans. Benjamin Keen (New Brunswick, NJ: Rutgers University Press, 1959), 15.

6. Cristóbal Colón, *Textos y documentos completos*, ed. Consuelo Varela (Madrid: Alianza Universidad, 1989), 277.

7. Oliver Dunn and James E. Kelley, Jr., eds. *The Diario of Christopher Columbus's First Voyage to America 1492-1493, Abstracted by Bartolomé de las Casas* (Norman, OK: University of Oklahoma Press, 1989), 252-53.

Pietro, near Sardinia, a vessel informed me there were two ships and a carrack with the said galleass, which frightened my people, and they resolved to go no further but to return to Marseilles to pick up another ship and more men. I, seeing that I could do nothing against their wills without some ruse, agreed to their demand, and, changing the point of the compass, made sail at nightfall; and at sunrise the next day we found ourselves off Cape Carthage, while all aboard were certain we were bound for Marseilles.[8]

By his early twenties, then, Columbus had acquired considerable sailing experience in the Mediterranean, and he had begun to venture into the Atlantic. Columbus's ten-year sojourn in Portugal, which began in the mid-1470s, deepened and broadened his seafaring experience immeasurably.[9]

During his years in Portugal Columbus embarked on many voyages, gaining valuable firsthand knowledge about the currents and winds, islands and shorelines of the ocean sea. His travels toward the north and northwest included visits to Ireland and England (probably), Flanders (possibly), and Iceland (plausibly), if we accept some equivocal evidence from his writings. Many of those writings are difficult to interpret, however, even when they are clearly phrased and genuine. The best evidence for an Irish landing is a marginal notation made in his copy of Aeneas Sylvius Piccolomini's *Historia rerum ubique gestarum*, which reads: "Men of Cathay came to the West. We have seen many notable things and especially in Galway, in Ireland, a man and a woman with miraculous form, pushed along by the storm on two logs."[10]

Evidence that Columbus also visited England and Iceland as well appears in a fragment of a letter he wrote to Fernando and Isabel from Española in January 1495. Unfortunately, it is preserved now only in a partial transcription made by Bartolomé de Las Casas, which raises questions about its accuracy, and even about its authenticity:

> In the year of 1477, in the month of February, I navigated one hundred leagues beyond the island of Tile, whose southern part is 73 degrees from the equator, and not 63, as some say, and it is not in the line which includes the West, as Ptolemy says, but much more westerly. And to this island, which is as large as England, the English go with merchandise, especially those of Bristol, and at the time I was there the sea was not frozen, although there were tremendous tides, so much that in some parts twice a day they rose twenty-five *braças* and they fall the same amount in height.[11]

The scholarly interpretations of this difficult phrasing range from denying that he made such a trip at all to accepting as fact that he visited Iceland. Perhaps the most striking aspect of the passage is that Columbus openly questioned the received wisdom from Ptolemy. As experience mounted, mariners such as Columbus would increasingly question aspects of the geography they had read and learned.

Columbus was a practiced observer of natural phenomena, and a single voyage to the latitudes of Ireland would have taught him a great deal about the currents and wind patterns in the north Atlantic. It is reasonable to suppose that he augmented his own observations through discussions with other pilots and navigators. If he was paying attention, he might have concluded that a northern route could indeed lead to the west, but that it was dangerous and difficult. More promising possibilities lay to the south.

Columbus unambiguously described his experiences in Africa and the Atlantic islands, leaving no doubt that he knew those areas well.[12] Beginning in 1482, he traveled as far south as the fortress of São Jorge da Mina, built on the Gold Coast, and he returned there at least once more. Sometime between 1482 and 1485, when he left Portugal for Spain, he noted that: "I was in the castle of La Mina of the king of Portugal, which is located beneath the equatorial arc, and I am a good witness that it is not uninhabitable, as is said."[13] During his voyages, Columbus wrote down explicit comparisons between the flora and fauna of the new lands he found and their equivalents in the Old World. Many of these comparisons reveal his familiarity with Africa. On the first voyage, for example, he wrote that Cuba ". . . has a great quantity of palms of a different sort from those

8. Ferdinand Columbus, *Life of the Admiral*, 11.

9. For a survey of Columbus's Portuguese connections, see William D. Phillips, Jr., "Christopher Columbus in Portugal: Years of Preparation," *Terrae Incognitae* 24 (1992): 31-41.

10. Varela, *Textos y documentos*, 9.

11. Varela, *Textos y documentos*, 167. Varela took this version from a manuscript by Las Casas in the Biblioteca Nacional in Madrid. The letter also appears in Hernando Colón's biography. As translated by Benjamin Keen, there are some differences. "In the month of February, 1477, I sailed one hundred leagues beyond the island of Tile, whose northern [*sic*] part is in latitude 73 degrees N, and not 63 degrees as some affirm; nor does it lie upon the meridian where Ptolemy says the West begins, but much farther west. And to this island, which is as big as England, the English come with their wares, especially from Bristol. When I was there, the sea was not frozen, but the tides were so great that in some places they rose twenty-six fathoms, and fell as much in depth." See Ferdinand Columbus, *Life of the Admiral*, 11.

12. William D. Phillips, Jr., "Africa and the Atlantic Islands Meet the Garden of Eden: Christopher Columbus's View of America," *Journal of World History* 3, no. 2 (1992): 149-64.

13. Varela, *Textos y documentos*, 167.

of Guinea and our own," and praised the clear waters and flowing rivers on the Caribbean islands, "unlike the rivers of Guinea, which are all pestilential."[14] Moreover, Columbus often used Portuguese words describing Africa when writing about plants, animals, and aspects of native culture in the Caribbean,[15] indirect but persuasive evidence that he visited Africa during his years in Portugal.

In that same period, Columbus traveled frequently to the Madeiras — both the main island and Porto Santo — and at least once he returned to Genoa. On those voyages, we can assume that he carefully observed the winds and currents, storing the knowledge away with his prior experience. The collection of real knowledge and sea lore that Columbus accumulated during his years in Portugal were invaluable as his grand design took shape.

Some scholars have suggested that Columbus's knowledge of the prevailing wind and water currents was the key ingredient in his plan to sail to Asia and return; once he had experienced the constant clockwise ellipse of winds west of Iberia, he knew the voyage was possible.[16] Perhaps this is true, but that is not to say that his knowledge was complete or flawless. On his outbound voyage in 1492, Columbus would choose a nearly perfect trajectory across the Atlantic, dropping down to the Canaries before heading due west. That is still the preferred sailing route from southern Europe to the Caribbean. On the return voyage, however, he tried to sail due east from the Caribbean, and was repeatedly beaten back by the northeast tradewinds. Only after several days of fruitless effort did he sail farther north and intersect favorable winds that carried him toward the Azores and Iberia. In other words, there is no simple explanation of how Columbus formulated his plans or why he was so sure they would succeed.

By the early 1480s, Columbus had acquired skills, knowledge, and experience that arguably helped to shape his notions about a westward route to Asia. He had learned to command a ship, which meant that he knew about practical navigation and geography. He had sailed to Portuguese trading stations in parts of the world unknown a generation before.

Beyond his own experience, the most important early sources of his ideas were probably simple: stories, rumors, and physical evidence. His son and biographer reported that Columbus "was impressed by the many fables and stories which he heard from various persons and sailors who traded to the western islands and seas of the Azores and Madeira."[17] The biography claims that Columbus had formulated his grand design before hearing the mariners' tales, but it is far more likely that these tales planted the first seeds of his idea. He knew that wealth had been made in new discoveries in Africa and the Atlantic islands, and he knew the honors that the discoverers and governors had received from grateful monarchs. He knew the potential riches that Asia offered. As he heard the stories that merchants and sailors told, of faraway riches and strange peoples and things from the west, he fitted them into a gradually developing design to explain the world — a design that constantly changed, becoming increasingly more elaborate, undergoing changes even after his first discoveries across the Atlantic.[18]

One group of stories concerned physical objects drifting in from the west. A Portuguese ship's pilot named Martín Vicente told Columbus that he pulled from the sea a piece of wood that had been carved, but not with iron tools. He was fifty leagues west of Portugal's Cape St. Vincent at the time, and the winds had been blowing from the west for many days. Vicente assumed that the wood came from unknown islands far out in the ocean sea. Pedro Correa da Cunha, who was related to Columbus by marriage, had encountered a strangely carved piece of wood, driven ashore on Porto Santo while he served as governor there. He also found pieces of canes unlike any others known to the Portuguese and "so thick that one joint held nine decanters of wine." The canes were so strange that Cunha had taken them to the Portuguese court, showing them to the king and speculating that they had come from nearby islands or perhaps even from India. In other words, both Vicente and Cunha believed there were inhabited islands to the west, close enough that a piece of carved wood might float into Portugal's orbit under certain circumstances.

Others told of tree limbs of unfamiliar species of pine floating ashore on the western rims of the islands of Graciosa and Fayal in the Azores. Strange covered boats and canoes found drifting in the ocean were assumed to have come from western islands. One famous story reported that the remains of two human beings with strange broad faces had floated on the same currents. The unknown winds and currents in the western ocean had previously been a powerful barrier, even to adventurous voyagers. By the late fifteenth century, Columbus was not the only one who thought seriously that the barrier might be breached.

Taken together, these stories suggested the strong

14. Ibid., 45 (28 October 1492) and 67 (27 November 1492).

15. Ibid., xxxvi-xl.

16. Paolo Emilio Taviani, *Christopher Columbus: The Grand Design*, trans. William Weaver (London: Orbis, 1985), 209-212.

17. Ferdinand Columbus, *Life of the Admiral*, 23.

18. Unless otherwise noted, the following account of the rumors Columbus gathered comes from ibid., 23-28.

possibility that inhabited islands lay fairly close toward the west. Even more intriguing, witnesses said they had seen those islands, and some even claimed to have visited them. Columbus collected many stories from people in the Atlantic islands who asserted that they regularly saw islands to the west, and a few who had actually sailed out to find them.

However fanciful the stories of western islands might have been, they coincided with ancient stories of islands in the ocean sea that had proven true in the centuries before Columbus. The Canaries, the Madeiras, the Cape Verdes, and the Azores had all been discovered relatively recently, seeming to confirm both ancient legends and modern firsthand accounts. The actual discoveries in the fourteenth and fifteenth centuries naturally led to the conclusion that there were more islands yet to find.[19]

Medieval tales, such as the story of St. Brendan and his Irish monks, also played a role in the formulation of Columbus's grand design. One of the most famous of the legends concerned the island of Antilia, whose presence was so little doubted that it ended up on many maritime charts, including those of the Portuguese, who showed it westward of the Canaries and the Azores. According to legend, Antilia first became important to European Christianity in the year 714, when the Muslims were engaged in the first phase of their rapid conquest of the Iberian peninsula. To escape the Muslim invasion, seven bishops loaded ships with their faithful followers and their belongings and sailed to the island. Each bishop founded a city, because of which Antilia is occasionally known as the isle of the seven cities. To break all ties with the old world that had fallen under Muslim domination, they burned their ships so none could return.

The legend of Antilia had been embellished by the late fifteenth century, with the addition of a story that in the time of Prince Henry that a Portuguese ship driven off course by a storm had landed upon an island. Much to their joy, the crew found the island to be inhabited by Christians. When the islanders learned that the crew was Christian as well, they asked them to remain until their king could be summoned. Fearing that the king might detain them in order to keep secret the island's existence, the ship's master and his crew fled and returned to Portugal. When their own king ordered them to return to the island, they fled Portugal as well, rather than comply. One possible explanation for this tale is that it is a garbled second- or third-hand account of a Portuguese landing in the Canaries, where Mallorcan missionaries had been at work since the fourteenth century converting numbers of Canarians to Christianity.

Columbus was still collecting stories on the very eve of his first voyage. A pilot from Palos named Pedro de Velasco had participated in the voyage of the Portuguese Diogo de Teive in the 1450s. Long afterward in 1492, he told Columbus of their long voyage southwest from the Azores and their subsequent northward loop to the latitude of Ireland. Because of the land birds they sighted, and the condition of the seas, they assumed that land lay fairly close to the west, but the approach of autumn persuaded them to return home instead of searching further.[20] Other sailors told of similar voyages to the west, at varying latitudes. Some had traveled west of Ireland, others west of the Azores, others west of the Madeiras, but all of them were searching for lands beyond the known areas of the ocean sea. The Portuguese crown, which sponsored many voyages of exploration down the African coast, also sponsored attempts to find new lands in the open ocean. The stories known to Columbus were also known to countless others, and many were as intrigued as he was by the prospect of lands to the west between Europe and Asia.

In this atmosphere of restless voyaging and speculation, it was only a matter of time before someone put together the evidence from all the tales and conceived of a voyage westward to reach Asia. Although Columbus was not the first to conceive such a plan, he was the first to persevere until he found backing for it.

In addition to practical experience and the inspiration of others, Columbus could draw on his own reading and geographical speculations. The late fifteenth century was the early age of the printed book, when new

19. The Atlantic was assumed to be filled with islands. For the legendary islands, see Vincent H. Cassidy, *The Sea Around Them: The Atlantic Ocean, A.D. 1250* (Baton Rouge, LA: Louisiana State University Press, 1968). Initially, some Europeans even thought that the islands Columbus reached in the Caribbean were additional islands of the Canaries. See Felipe Femández Armesto, *Before Columbus: Exploration and Colonization from the Mediterranean to the Atlantic, 1229-1492* (Philadelphia: University of Pennsylvania Press, 1987), 221, citing M. Giménez Femández, "América, 'Ysla de Canaria por ganar'," *Anuario de Estudios Atlánticos* 1 (1955): 309-336. The first Italian version of the 1492 voyage referred to the Caribbean islands as "nuove insule de Channaria indiane," Giuliano Dati, *The History of the Discovery of the New Indian Islands of the Canaries*, ed. and trans. Theodore J. Chachey, Jr. (Chicago: The Hermon Dunlap Smith Center for the History of Cartography, The Newberry Library, 1989).

20. The date of the Diogo de Teive voyage is hard to ascertain. He made one important voyage to the Azores in 1452; Pedro de Velasco could easily have accompanied him and lived to tell Columbus about it some forty years later. But the pilot was said to be from Palos de Moguer, a name for the town that changed to Palos de la Frontera in the last decade of the fourteenth century, far too early for its pilot to have lived to tell Columbus about it. Official names are not always reflected in popular usage, however. The 1452 date for the voyage seems likely.

typesetting techniques made a variety of books available much more cheaply than ever before. Columbus had access to a wide range of notions about the size and configuration of the known world and its peoples, as well as the cosmos beyond, from ancient writers recently reprinted and from recent writers commenting upon them. From that range of scholarly opinion, Columbus would bolster his notions about the feasibility of sailing west to reach Asia, trying to impress his would-be patrons with the support of scholarly opinions.

Unfortunately, Columbus did not write down his geographical ideas in detail until his third voyage across the Atlantic, so one cannot date their evolution with any precision. The usual tendency among his biographers is to assume that he formulated a full set of geographical hypotheses about the size and configuration of the earth before seeking support at the Portuguese court, and that he simply kept trying to sell the same fully developed theory elsewhere after being rejected in Portugal. Nonetheless, it seems more reasonable to suppose that his geographical hypotheses grew incrementally, beginning with a fairly simple idea of sailing west to reach the Indies and later adding evidence from academic geographers to buttress his case. The publication dates of the books upon which he relied support — but certainly do not prove — this scenario. His copy of Ptolemy's geography was published in Rome in 1478; his copy of Aeneas Sylvius Piccolomini's *Historia rerum ubique gestarum* in Venice in 1477; and his copy of Pierre d'Ailly's *Imago Mundi* in Louvain between 1480 and 1483. He may or may not have consulted them before making his case to the king of Portugal, but at least they were on the market. Columbus's copy of Marco Polo, on the other hand, was a Latin summary published in Antwerp in 1485, and his Pliny *(Historia naturalis)* was an Italian translation published in Venice in 1489. He might have known other editions of these works before getting his own copies, but he may not have consulted them at all until after his arrival in Spain in 1485.[21]

The principal scholarly texts about geography did not offer European mariners much practical assistance. Over the centuries, however, scholars had developed enough information to suggest that ocean routes to Asia were possible. Academic geographers did not always agree with one another, or with ancient authorities, but their speculations stimulated discussion and controversy.[22] By the late fifteenth century Columbus, along with other merchants, popes, and princes, could pick and choose among the available theories, selecting interpretations that were the most persuasive or the most congenial to their own opinions.

In 1264 Roger Bacon had published his *Opus Majus*, which summarized ancient geographical knowledge and integrated contributions from Muslim geographers in the Middle Ages. Bacon accepted the view common in his time: the habitable portion of the world was composed of three parts (Asia, Africa, and Europe) and the rest of the globe was covered by oceans. In a crucial break with tradition, however, Bacon rejected the common notion that seas and lands near the equator were too hot for human beings to survive. Instead, he believed that Asia and Africa extended downward beyond the equator and could be inhabited. Once scholars began to doubt the existence of a Torrid Zone, the possibility of southerly voyages lost their fearsome quality.

Bacon's work was only one of many speculating about the shape and character of the world and questioning the wisdom of ancient and medieval authors. The geography of Ptolemy, greatest of the ancients, was translated into Latin in the early fifteenth century, providing a convenient framework for depicting the terrestrial globe in graphic form. Among his other contributions, Ptolemy divided the earth into 360 degrees, which became the basis for subsequent western maps. He did, however, make two fundamental errors. In the first, his estimate for the size of the earth was about one-fifth too small. In the second, he described Africa and Asia as being joined at their tips. This configuration would have made the rich trading network of the Indian Ocean inaccessible to ships sailing from Europe. Fortunately, there were other opinions to choose from. Aeneas Sylvius Piccolomini (later Pope Pius II) published a work in the early fifteenth century summarizing much of Ptolemy's geography but rejecting the idea that the Indian Ocean was an enclosed sea. When Columbus was assembling academic support for his grand scheme in the late fifteenth century, he undoubtedly read Piccolomini's work and probably found it appealing.

Pierre d'Ailly, an early fifteenth-century cardinal, published a geographical work called *Imago Mundi* that was to have a great influence upon many European scholars, merchants, and mariners, among them Columbus. The cardinal relied heavily on geographical treatises by classical and Muslim scholars, and, to increase the accuracy of his work, or so he believed, he

21. See the sources cited in Taviani, *Grand Design*, 84-89, 174, 396-98, 450-55.

22. On the geography of the fifteenth century, see J.R.S. Phillips, *The Medieval Expansion of Europe* (Oxford: Oxford University Press, 1988); J. H. Parry, *The Discovery of the Sea* (Berkeley and Los Angeles: University of California Press, 1981); N. Broc, *La géographie de la Renaissance* (Paris, 1980).

disregarded the accounts of mere travelers such as Marco Polo. Nonetheless, he made several basic errors, exaggerating the size of Asia and underestimating the extent of oceans on the face of the earth. He was thus able to conclude that a westward voyage from Europe to Asia was eminently possible. Other geographers at the same time estimated the size and shape of the earth much more accurately than d'Ailly. He remains important, however, because Columbus enthusiastically adopted his calculations and used them as a basis for his grand scheme.

Columbus's access to the Portuguese court presumably increased the store of knowledge he had accumulated. At the Portuguese court, all manner of geographical and cosmological speculations were discussed, as were the most recent exploratory voyages to the African coast and the Atlantic islands. Even if Columbus himself was not in regular attendance at court, his wife's relatives were. Along with other information from the court, Columbus found inspiration in a letter sent to the King of Portugal by the Florentine Paolo dal Pozzo Toscanelli. A typically versatile Renaissance intellectual, Toscanelli was a geographer cum businessman who worked for the Medici bank. Among his other pursuits he made maps. In 1459 he interviewed several Portuguese who were familiar with West Africa and India, in order to bring their on-the-spot observations to bear on a world map he was preparing. Toscanelli wrote to the Portuguese king in 1474 that one could reach Quinsay (Hangchow) in China by sailing west for five thousand miles, breaking the trip with stops at the islands of Antilia and Cipango (Japan). The king did not follow up on Toscanelli's suggestion, which was based in part on Marco Polo's exaggerations of the size of China and the distance between Japan and the mainland of Asia.[23] Nonetheless, Toscanelli's letter was discussed in Lisbon and was commonly known to those who frequented the court, including — one can safely assume — Columbus's in-laws. Columbus supposedly wrote to Toscanelli himself in 1481, receiving in return encouragement and a copy of the letter and map that had been sent to the King of Portugal in 1474. Whether or not any correspondence really occurred between Columbus and Toscanelli (and some doubt it), Columbus clearly knew about Toscanelli and his theories.

The figure Columbus calculated for the length of a degree along the "equinoctial circle" or equator — 56.66 *millas* — agreed with many ancient and contemporary sources. Multiplying that figure by 360 degrees produced his estimate of 20,400 *millas* for the earth's circumference. Scholars disagree about the length of the mile that Columbus used. Most call it a Roman or Italian mile, but their estimates range between about 4,810 and 4,860 modern feet. Even if Columbus's mile corresponded to the larger figure, his estimate for the earth's circumference was equivalent to under 19,000 modern statute miles of 5,280 feet each. The real length of a degree at the equator is 69 statute miles, and the real circumference of the earth is about 24,900 statute miles, or 32 percent higher than Columbus's estimate.[24]

In his writings, and especially in the *Book of Prophecies*, Columbus cited numerous authorities, including forty-two books of the Old and New Testaments, twenty-one ancient Greek and Roman authors, and thirty-three medieval Jewish, Muslim, and Christian writers. Nevertheless, it seems that most of the citations came not from the sources themselves, but from the citations and quotations contained in Pierre d'Ailly.[25] From Marco Polo, Columbus derived an exaggerated notion of the wealth of Japan. He almost certainly used Polo's description (repeated in the Toscanelli letter) of the gold-encrusted temples and palaces of Japan as a selling point to gain support. Pierre d'Ailly may have been the sober geographer, but for Columbus, Marco Polo the merchant was more persuasive.

In developing his theory that a westward voyage to Asia was not only possible but practical, Columbus adopted the same erroneous notions from his readings that had influenced Toscanelli and others. With minor variations, they each believed that the continent of Asia stretched some thirty degrees farther to the east than it really does, and, following Marco Polo, that Japan lay 1,500 miles to the east of the Asian continent.[26] Following those premises, the open ocean between Europe and Asia shrank to a manageable size, with hospitable islands along the way. On the basis of his sources, Columbus calculated a distance of only 2,400 nautical miles from the Canaries to Japan; the real distance is 10,600 nautical miles. In other words, Columbus chose a set of figures that made his enterprise plausible, and it is hardly surprising that experts at the Portuguese and Castilian courts failed to agree with his

23. Parry, *Discovery of the Sea*, 118, 123-24; 181-82, 189.

24. See George E. Nunn, *The Geographical Conceptions of Columbus. A Critical Consideration of Four Problems* (New York: American Geographical Society, 1924; repr. New York: Octagon Books, 1977), 1-30. See also Taviani, *Grand Design*, 413-16.

25. Delno West, "The Intellecual and Cultural Background of Christopher Columbus," in *Book of Prophecies*, 7-40, esp. 22-26.

26. The distance came from Marco Polo. In a modern edition, the statement is: "Japan is an island far out to sea to the eastward, some 1,500 miles from the mainland [of Asia]." *The Travels of Marco Polo*, trans. Ronald Latham (Harmondsworth, UK: Penguin, 1958, repr. 1982), 243.

premises or with his conclusions. After all, the great Ptolemy had calculated a degree nearly 18 percent longer than Columbus's figure, which would have put Asia much farther away, perhaps out of reach of European ships.

The geographical ideas of the late fifteenth century were depicted most strikingly by Martin Behaim in 1492. Behaim's globe presented a view of the world almost identical to that of Columbus. The Americas were totally missing, of course, and Behaim placed Japan far distant from the mainland of Asia and showed the ocean between Europe and Asia strewn with islands. As far as we know, Columbus and Behaim had no contact with one another, but their conceptions of the world, both stemming from the academic geography available at the end of the fifteenth century, agreed almost entirely.

Columbus was certainly familiar with European world maps. On November 14, 1492, during his first voyage, he reported seeing countless beautiful islands, all heavily forested, and he described the mountains of eastern Cuba as the highest in the world. He was certain he had reached Asia, for he thought that "these islands are those innumerable ones that in the maps of the world are put at the eastern end."[27] He revealed in his *Book of Prophecies* some of the biblical evidence that he used to supplement his other sources. These included stories of islands discovered and prophecies fulfilled. Early in his third voyage, when he reached the mouths of the Orinoco River on the South American mainland, he thought he had approached the terrestrial paradise, described in the Bible and also placed on European maps at the eastern extreme of Asia.[28] His search for gold was in part a search for the legendary mines of Ophir, where King Solomon secured the gold to build his temple in Jerusalem. Columbus believed Ophir was located in India, and he went to his death believing he had reached Asia, not some lands previously unknown to both Europeans and Asians.

He was also familiar with the system of using grid lines in mapping. Toscanelli used the concept of plotting grids on maps to indicate both latitude and longitude. Columbus learned from this, as is shown by the phrase he used in a letter he wrote to the pope in 1496 (and may never have sent): "I traveled ten lines of the other hemisphere."[29]

Before he could write to the pope, he had to have made the voyages. Before that was possible, Columbus devoted nearly a decade to seeking the funding for his first voyage. Sometime before 1485, using the geographical ideas he had developed up to that point, Columbus first sought backing for his proposed westward voyage to Asia. He tried first to interest King João II of Portugal in his scheme. João refused, and Columbus moved to Spain to seek support, which he only obtained after more long years of persistent petitioning. What sustained him over the entire period was his unswerving conviction that he was receiving divine inspiration and guidance. His voracious reading, his religious faith, his collection of mariners' tales, and his practical experience all combined to persuade him of the feasibility of reaching Asia by sailing west from Europe. His credulity, his amateur's enthusiasm unchecked by scholarly skepticism, and his naturally stubborn nature all combined to prevent him from understanding what he really found.

27. Dunn and Kelley, *Diario*, 152-153.

28. Varela, *Textos y documentos*, 215-18.

29. The Spanish reads: "Yo anduve dies líneas del otro emisperio." Ibid., 311.

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Dynamics of Change in the Magnitude of Geographical Coordinates in Ancient, Islamic, and Western Civilization

RALPH W. BRAUER

In the days before actual measurement of differences in longitude was practicable, and before there were any formal conventions regarding the position of the prime meridian,[1] accepted magnitudes of these fundamental qualities of mathematical geography were established by prominent geographers or astronomers. In the intervals between the times when such experts flourished, the accepted value was fixed by adherence to established authority. The so-called cosmographers who confronted Columbus, declaring his project to be in conflict with Aristotle and therefore impossible,[2] no doubt held such a point of view. Understanding the actual situation, however, requires the aid of adequate quantitative data. Such data have not hitherto been available to any medieval geographers, but this author has developed a new method of comparison of medieval and modern coordinate tables capable of providing much of the needed information.

A first look at the resulting series of values shows such wide scatter of numbers as to suggest that the facts in no way correspond with accepted views. Frequency distribution diagrams such as those for the Arabo-Islamic geographers shown in figures 1 and 2 (see page 278) suggest a random process rather than the small number of discrete values implied by the literature. Two main factors underlie these distributions. The first is the profusion and confusion of units employed in the expression of the results of such measurements as were supposed to exist.[3] The second is the probability that the length of the degree assumed at any given time was in fact the result of the interaction of what was supposed to be the current choice of the scholarly cosmographers with the experience of men of practice. The latter, of course, were the ones who had to live with the consequences of that assumed value, yet their opinions may well have diffused only slowly and irregularly into the realm of the learned to find their expression eventually in compromise values of the basic parameter. This study will be confined largely to tracing the actual development of the numerical values, limiting their interpretation to some hypotheses to be examined and tested in greater detail in the future.

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THE CASE OF CLAUDIUS PTOLEMY

Claudius Ptolemy (85 to 170 AD) was the channel through whose work much of the theory and practice of geography acquired during Mediterranean classical antiquity was transmitted to the geographers and astronomers of the medieval Arabo-Islamic world and, four centuries later, to Western European civilization. Values of the length of the degree ascribed to this scholar in the literature range from 75 to 110 km, and he is frequently accused of having promulgated grotesquely excessive values for the length of the Mediterranean Sea. As a consequence he has tended to receive low grades as a mathematical geographer if not as an astronomer. What are the facts?

Ptolemy's main bequest to posterity is in fact not his explicit statement as to how long he thought the degree was — a figure clouded by our ignorance of the actual length of the *stade*, the unit of length he employed — but rather his extraordinary tables of the geographical coordinates of more than 8,000 localities.

1. A period which, despite the insight of scholars such as Hipparchus, Ptolemaeus, or al-Biruni, did not really end until the development of the method of calculating lunar distances in the final years of the fifteenth century AD or the beginning decade of the sixteenth.

2. W.G. Randles, "The Evaluation of Columbus' India Project by Portuguese and Spanish Cosmographers in the Light of the Geographical Science of the Period," *Imago Mundi* 42 (1990): 50-64.

3. As an example, analysis of the data for the Arabo-Islamic geographers suggests that the combinations of assumed length of the mile and assumed numbers of miles to the degree define no fewer than six cells of a matrix, and that every one of these cells is occupied by one or more authors. Twenty-one authors favor the Syrian mile of 1.48 km and calculate a degree at 56⅔ miles (3), 66⅔ miles (13) and 75 miles (5), respectively. Eight authors use the Arabic mile of 2.00 km, of which five calculate the length of a degree at 56⅔ miles, one at 66⅔ miles, and two at 75 miles.

Many of these places have remained recognizable over the nearly two millennia since his *Cosmographia* was written and can thus be compared directly to modern values. For the longitudes, the correlation turns out to be extraordinarily good: a plot of Ptolemy's longitudes against modern ones for a sample of twenty-six localities conforms to a straight line with a correlation coefficient of better than 0.98 over a range of more than 110° (see figure 3 on page 278). The slope of this line, however, is only 0.67, revealing that Ptolemy's equatorial degree of longitude at 0.67 x 111.3 km was 74.4 km, which was more than 30 percent shorter than the 111.3 km now established (see table 1 on page 277). Incidentally, since Ptolemy himself specified that his degree was 500 *stades* long, the length of the *stade* he used can be computed at 0.149 km. This figure is close to, and perhaps indistinguishable from, the Greek *stade* of 0.159 km and thus about 20 percent shorter than the Roman one at 0.181 km — a difference responsible for a good deal of the confusion regarding the interpretation of Ptolemy's data.

Applying the same methods to the data for geographical latitude in Ptolemy's *Cosmographia*, one finds that correlation with modern values is as good as that for the longitudes. However, the slope here is greater than 0.9. Provided that one translated that value to a linear measure as was done above in the case of longitude, this would seem to imply that the length of Ptolemy's degree of latitude was more than 20 percent greater than that of his degree of longitude. As a consequence, one would have to infer that he thought in terms of the earth as being a grossly prolate spheroid (see table 2 on page 277) instead of being a perfect sphere.[4] The fact is, however, that Ptolemy nowhere referred to the length of the degree of latitude or to the strange spheroid shape of the earth implied by his coordinate data. On the contrary, he repeatedly mentions the fact that the earth is spherical. It seems safe to conclude that he did indeed think in terms of a spherical earth, the dimensions of which conformed to the length of the degree as he specified it — that is, 500 of his *stades* — and hence substantially smaller than that currently accepted, with a volume only 34 percent of the terrestrial sphere as it is known today. This apparent inconsistency reflects the fact that Ptolemy's latitudes were based on astronomical measurements which yielded directly the angular latitude values he reported in his tables. By contrast, the longitudes started out as geodetic data and had to be transformed into the angular distances shown in his tables by being divided by the length of the degree that Ptolemy, following Posidonius and Marinus of Tyre, had chosen to accept. Thus, Ptolemy might well never have had reason to look at the two discordant sets of linear data side by side.

There is finally the matter of the length of the Mediterranean Sea. Based on Ptolemy's tables, one must conclude that the angular length seems indeed excessive: 62° as against 42°, the modern longitude distance between Ceuta (close to the southern Pillar of Hercules of Ptolemy's time) and Antioch. However, multiplying those figures by the length of the degree appropriate to each and corrected to a latitude of 36°, the mid-latitude of the Mediterranean Sea, one finds that Ptolemy's Mediterranean at 3,732 km was actually shorter than the modern estimate (see table 3 on page 277) — but that the two differed in fact by only 1.8 percent! Here, then, is further evidence, if any were needed, that Ptolemy was perfectly aware of the relation between angular and linear measurements of longitude differences but thought in terms of a substantially shorter degree.

PTOLEMY AND AL-KHWARIZMÎ

More than 650 years passed between the time when Ptolemy wrote and the time when Arabo-Islamic geographers began to be concerned with mathematical geography. During this time, the tradition of the manuscripts of the *Cosmographia* persisted in Byzantium, and from there at least one manuscript found its way to Khalif al-Ma'mun's translators.[5] The only reasonably complete version of the product of their labors appears in the coordinate tables of the *Kitâb suratu 'l-'ardh of Abû Ja'far Muhammad ibn Musâ al-Khwarizmî* of 820 AD.[6] These extensive tables reproduce many of the localities found in Ptolemy's *Cosmographia*. As a result, the same methods that served above to compare Ptolemy's data with the corresponding modern ones can be used to compare Ptolemy's with al-Khwarizmî's data. The correspondence between the two sets of longitudes is very good indeed (see figure 4 on page 278). The overall linear correlation coefficient is 0.96, and the regression line passes through a point very close to the origin, effectively implying a common null

4. This apparently has gone unnoticed since the single mention of it in the eighteenth century in M. Gosselin's *Géographie des Grecs* (Paris, 1790).

5. In fact, none of the original manuscripts of Ptolemy's *Cosmographia* have come down to the present. When mentioned above the edition used here is the Latin Buckinck edition (Rome, 1478), presumably a faithful translation of the Greek manuscript brought to Florence in 1409. Thus, the comparison of the two series here at issue serves to test the extent to which the tables of the *Cosmographia* were preserved over the six-hundred-year interval between the earlier Arabicized and the later Latinized versions of the Greek manuscripts existing in Byzantium.

6. H. von-Mzik, *Das Kitâb Surat al-ardh des Abû Ja'far Muhammad ibn Musâ al-Khwarizmî* (Leipzig, 1926).

meridian. However, the slope of the line correlating the two series of data is not 1.00 but only 0.80. This can only mean that all of Ptolemy's longitude data have been altered consistently for entry into al-Khwarizmî's tables by being multiplied by 0.80, a transformation implying that al-Khwarizmî must have used a degree of longitude 20 percent longer than Ptolemy's. Application of the same methods to the comparison of Ptolemy's with al-Khwarizmî's latitude data produces a line with a slope very close to 1.00, indicating that, while the geodetically based longitude data were deliberately revised, the astronomically based latitude data were not. This is one of the rare instances of an abrupt transition in the history of this subject — a transition which established the point from which all subsequent medieval Muslim geographers took off. No doubt it reflects government interposition: Khalif al-Ma'mun, aware of the uncertainties surrounding Ptolemy's choice of the length of the degree, had ordered in the early years of the ninth century a renewal of Eratosthenes' measurement of the length of that parameter.[7] Since al-Khwarizmî was almost certainly a member of the commission entrusted with this (double) effort, it is likely that the 93 km degree of longitude which underlies his tables represents also the hitherto merely guessed-at result of that effort — a value almost precisely midway between Ptolemy's 74.4 km and the modern 111.3 km.

Figure 4 on page 278 reveals that the degree of correlation between the two sets of data is not constant throughout the entire range but is strikingly better at longitudes west of 70° — a longitude passing midway through Mesopotamia in Ptolemy's tables (see table 4 on page 277). This implies further active revision of the Alexandrian author's tables in the eastern districts, where presumably Arabo-Islamic workers had acquired new and better data in the years since the Islamic conquest. Whether this, too, reflects Khalifal dictum or is rather a first example of transfer to the scholarly literature of the results of the experience of travelers and caravaneers is a matter open to further inquiry.

THE ARABO-ISLAMIC GEOGRAPHERS 820-1500 AD

The medieval stage of Arabo-Islamic geography spans approximately 650 years from 800 to 1450 AD, and during this period more than sixty authors who wrote concerning the subject included with their texts tables of geographic coordinates which can be analyzed by the same methods already applied to Ptolemy's work.[8] Thirty authors whose writings date from 820 to 1580 AD furnished data for such an analysis. In all cases, the longitude data for series of fifteen to twenty-five localities were closely and linearly correlated with the corresponding modern data as shown by the distribution of correlation coefficients with a mean value of 0.98 ± 0.02. The estimates of the length of the degree of longitude derived from the individual regression calculations have an average standard error of 7.26 ± 0.74 percent and yield a mean length of the degree of 99.16 ± 2.22 km, with a standard deviation for the individual estimates of 9.0 km, close to that predicted from the uncertainty in the individual regression derived values (that is, 7.20 km). A plot of the distribution of the individual computed lengths of the degree as a function of the date of publication was done for the entire period from 820 to 1600 AD. The slope of the regression line for this parameter on the date of the respective work is not significantly greater than zero: 0.006 ± 0.005 km/yr (P=0.27). Thus, the results of this analysis suggest that following the establishment of the Ma'munian degree, over the succeeding seven centuries during which one can speak of an Arabo-Islamic geography, the average length of the degree of longitude increased by less than 10 km. The texts contain no hint to show that there was any deliberate choice in the matter, and there is no further remeasurement of the length of the degree in the medieval Arabo-Islamic literature after the Ma'munian effort.[9]

The second factor which determines the actual longitude values listed is the location of the prime meridian chosen by a given author. This null longitude can be deduced either from the correlation diagrams for the authors or from the longitudes of towns near the western terminal of the oikumene.[10] Both calculations lead to identical conclusions. Here, the characteristics of

7. J.T. Reinaud, trans., *La géographie d'Aboulféda*, vol. 1 (Frankfurt am Main, 1985), xlvi-li and cclxix-cclxxii; Y.T. Langermann, "The Book of Bodies and Distances of Habash al-Hasib," *Centaurus* 28 (1985): 108-128.

8. E.S. and M.H. Kennedy, *Geographical Coordinates of Localities from Islamic Sources* (Frankfurt am Main, 1987). This is the source for all of the data utilized in this analysis except for those of the Muslim geographers for which specific reference to the original literature is given.

9. Abû Raihan Muhammad ben Ahmad al-Biruni's *Kitâb al-tahdid nihaydt al-amâkin li tashih masâfâkin*, ed. Jamil Ali (Beirut, 1967) set out the basic concepts for applying spherical trigonometry to geodetic measurements of long distances and applied these methods to the determination of differences in longitude between two localities. However, he converted his measurements to longitude differences using a value for the length of the degree taken from the writings of al-Farghani or Habash al-Hasib, values which are clearly derived from the Ma'munian measurement of the degree.

10. This requires knowledge of the medieval as well as the modern longitude of the locality as well as of the length of the medieval author's degree relative to the modern one. Limiting the choice to localities near the western end of the oikumene minimizes the effect of uncertainties in these parameters.

the resulting distribution will be illustrated on the basis of calculations performed for eight towns in the western Iberian peninsula and in Western Morocco (Cordoba, Toledo, Sevilla, Granada, and Malaga in al-Andalus, and Tangier, Fas, and Marrakesh in the Maghrib al-'aqsâ) on the basis of the tables of twenty-five Arabo-Islamic authors writing during the period from 820 to 1580 AD whose tables extend far enough to the west (105 points in all. The null longitudes range from about 12° W of Greenwich to about 37° W, corresponding to a spread from just east of the Canary Islands to somewhat west of the westernmost of the Azores. Frequency analysis shows that the null meridians are grouped in three well-defined series, centered on 13 or 14°, 19°, and on 27°W. Separating the data into two sets before and after 1250 AD and constructing the frequency distribution plots demonstrates that the preferred null meridian shifted westward in the course of time. In the set reported prior to 1250 the Canaries predominate, while after 1250 the Canaries represent less than one-third of the sample. The evidence suggests that the changeover occupied a period of about a century and even then was less than complete.

In this case it is possible to speculate on some of the causes underlying the event, even though the texts once again fail to contain formal notice of any change in intent.[11] Three factors come to mind which separately or conjointly might have made a westward shift of the prime meridian seem attractive about the beginning of the thirteenth century.

First, the increased length of the Ma'munian degree relative to the Ptolemean one may have become significant in light of Ptolemy's insistence on 180° as the length of the inhabited world. Given the emphasis on geodetic measurements of longitude, Arab authors might well have realized that Ptolemy's 180° would have occupied a distance equivalent to only 135 of the new degrees; adhering to Ptolemy's 180° figure, they might well have concluded that this called for expansion of the range of the oikumene by 45°. It would have seemed logical to achieve this by adding about 22° at each end, in particular in the west, by shifting the null meridian by this amount.

Second, it was widely accepted throughout the Muslim Middle Ages that the Qubba Arin was the center of the inhabited earth and as such should be 90° from either end of the oikumene. Laguarda Trias has called attention to eclipse observations performed in newly established observatories in al-'Iraq and especially in al-Andalus during the twelfth century which indicated to scholars in Toledo that their city was only about 63° distant from the presumed site of the Qubba 10° east of Baghdad. Consequently, its longitude should not have been 11°, as in many of the then-current tables, but 27°, requiring a shift of the prime meridian westward by 16°.[12]

Third, a comparison of al-Idrisi's 1154 AD[13] and Ibn Sa'id's 1286 AD[14] geographies shows a dramatic increase in Arab awareness of the western Atlantic Isles, and probably in particular of the Azores, between the dates of writing of the respective works. This might well have given support to suggestions that the null meridian be shifted westward to take into account the newly acquired geographic knowledge, presumably anticipated by the wise men of the past, and the Azores would be a likely terminal point for the newly recognized extension of the oikumene.

Each of these factors would have favored a westward shift of the prime meridian by about 20°, and at least two of the lines of reasoning would have become effective toward the end of the thirteenth century. Clearly, too, the event was a gradual shift, as though a prevailing opinion gave way a bit grudgingly before the slow accumulation of arguments in favor of a realignment.

Western Europe to the Age of Discoveries

Arabo-Islamic geography faded out in the fifteenth century as the Ottoman Turks gained the ascendancy and their empire increasingly superseded what was left of the former Islamic Empire. Their geography enjoyed a brief span of creativeness in the works of Piri Reis[15] and Sidi 'Ali, Kâtib-i Rûmî,[16] but then receded into relative insignificance. In its place, the lead passed to the peoples of western Europe, reinforced at the beginning of the fifteenth century by refugees from Turkish domination who, among other things, brought with them to the west the manuscripts of Ptolemy's

11. Kennedy and Kennedy's suggestion that a distinction can be made between authors claiming to have used the Eternal Isles and others claiming to have used a point on the West African shores of the Sea of Darkness (the Atlantic) does not correlate effectively with the results of our analysis of a limited series of Arabo-Islamic authors.

12. R.A. Laguarda Trias, *La aportación científica de Mallorquines y Portugueses a la cartografía nautica en los siglos XIV al XVI* (Madrid, 1964); cf. also Aydin Sayili, *The Observatory in Islam* (New York, 1981), 178-184.

13. al-Idrisî, abu 'abd allah muhammad ibn muhammad 'abd allah ibn idris al hammudî al-hasânî, *Kitâb nuzha 'al-mushtâq fi-'khtirâq al-afâq*, eds. E. Cerulli, et al. (Leiden, 1970).

14. Ibn Sa'id al-Maghribî, *Kitâb bast al-ardh fi-t- tul wa-'l-'ardh*, ed. J.G. Ginés (Tetuan, 1958).

15. Piri Re'is, *Bahriye*, trans. P. Kahle (Leipzig, 1926).

16. W. Tomaschek, trans., *Die Topographischen Kapitel des Indischen Seespiegels Mohît- K.K. Geographische Gesellschaft* (Wien, 1897).

geography from the former Byzantium.

The tables permit, by the same treatment discussed above, the extraction of the length of the degree implicit in their data. The texts, too, are at times sufficiently specific to furnish the corresponding values.[17] The earliest set of data, contained in the Alfonsine tables of 1272 AD, implies a degree 86 km long, even shorter than the Ma'munian degree as reflected in al-Khwarizmî in 820 AD, more than 450 years earlier. In the sequel, the assumed length of the degree increased rapidly so that most of the sources produced after 1300 AD used a degree of 105 km or greater. This, however, was not universally accepted by the scholars; for instance, Nicole d'Oresme in 1370 thought in terms of 90 km,[18] Cardinal Pierre d'Ailly in ca. 1415 thought in terms of a degree 83 km long,[19] and as late as 1574 AD an English writer on navigation, Bourne,[20] implied a degree equivalent to about 90 km.

The early cartographic material pertinent to the present inquiry consists of the long series of so-called portolan charts prepared in the Mediterranean area — largely Italy, Catalonia, and Mallorca — for use by mariners.[21] These charts are almost devoid of detail inland but present extensive series of localities along the seacoasts of the entire Mediterranean Sea and often of the Atlantic shores of what are now Spain, Portugal, and parts of western North Africa. Their preparation coincided with the introduction of the boxed magnetic compass into navigational practice. The portolans prior to 1600 AD all are skewed 7 to 10° counterclockwise as evidence of the fact that they were drawn from data obtained with the aid of the magnetic compass by men ignorant of, or deliberately ignoring as irrelevant, the deviation of the magnetic compass characteristic of the time and reasonably constant throughout the length of the Mediterranean.[22] Their scaling was designed to permit navigators to follow a compass course from port to port over the relatively limited latitude range of the Mediterranean Sea, and distance scales were uniform regardless of direction. This implied a distortion of angular scales reflecting the progressive reduction in the length of a parallel circle in proportion to the cosine of the latitude as one moves away from the equator. Scales of distances form part of virtually all of the charts, and by comparing actual longitudinal distances with the scales one can show that these are based on a mile close to 1.23 km, the portolan mile, resulting from conversion of the equatorial mile of 1.48 km, the Italian mile, to the latitude of 34° (or a 1.59 Catalan mile to the latitude of Mallorca, i.e., 39°). Laguarda Trias has called attention to a convention apparently followed by most of the makers of portolan charts according to which angular distances E-W (that is, longitude differences which could not be determined directly) were referred to the N-S distance (that is, a latitude difference which could be controlled by astronomic observation) from Cape San Vicente to the main one of the Berlenga Islands, the distance being assumed to be 3°. Since the actual angular distance between these points is just under 2.5°, this convention implicitly corrects the longitudes for the cosine effect. Using this distance as a yardstick for the length of the Mediterranean Sea and comparing it to the linear distance inferred from the scales on the margin of each chart, one can then compute the length of the degree envisioned by the cartographer. Values obtained in this fashion for eight portolan charts show the corresponding angular lengths of the Mediterranean Sea. The results suggest a progression from a degree less than 90 km long before 1450 AD to a degree greater than 90 km after that date, and from a Mediterranean longer than 50° to one shorter than 45°, reflecting this change in the length of the degree.

Laguarda Trias has made direct comparisons between the reference distance and the scales of no fewer than eighty-six portolan charts dating from 1270 to 1650 AD. Figure 5 on page 279 shows a plot of his results.[23] They confirm the trends noted above and reveal an unmistakable progression from a series dominated by a degree of longitude of about 85 km before 1450 AD to a series in which values above 100 km predominate. At the same time, the data show that

17. Tables used in the analysis were the Alfonsine tables, 1272; Almanaque de Tortosa, 1307; Nicholas de Torres, 1487; and Abram Zacut, 1496. Texts used were Duarte pacheco-Esmeralda Orbis, 1505, and Nicole d'Oresme, 1370. Charts used were Dulcert, 1339; de Virga, 1409; Viladestes, 1413; Valseccha, 1447; two anonymous charts of 1510 and 1585, respectively; and Martines, 1587. The Carta Pisana of ca. 1280 was omitted since it does not show the Atlantic coast of the Iberian Peninsula for the reference distance.

18. Nicole d'Oresme, *Quaestiones de sphere*, Ms. 117, Biblioteca Riccardiana, 1370-f.125r-135r.

19. Cardinal Pierre d'Ailly, *Ymago Mundi*, trans. E. Buron, 3 vols. (Paris, 1930).

20. W. Bourne, *A Regimen of the Sea* (London, 1574).

21. M.A. Clos-Arceduc, "L'énigme des portulans - étude sur sa projection et le mode de construction des cartes du XIVe et du XVe siècle" *Bulletin de communications Travaux Historique et Scientifique* 69 (1956): 216-231, and M. de la Roncière, and M.M. du Jourdin, *Les portulans* (Fribourg, 1984); cf. also E.L. Stevenson, *Portolan Charts* (New York, 1911).

22. J.T. Lanman, *On the Origin of Portolan Charts* (Chicago, 1987), and J.C. Tanguy, I. Bucur, and J.F.C. Thompson, "Geomagnetic Secular Variation in Sicily and Revised Ages of Historic Flows from Mount Aetna," *Nature* 318 (1985): 453-455.

23. R.A. Laguarda Trias, *La ciencia Española en el descubrimiento de America* (Valladolid, 1990).

each given value for the length of the degree was in use for 100 to 150 years and that there was an overlap of more than 50 years between successive stages. Indeed, isolated charts making use of a degree of 111 km (the modern value) appeared at all times from 1420 AD on. All of this, once again, bespeaks change by a gradual progression rather than by any abrupt steps.

Figure 5 includes a specially marked point which represents the length of the degree assumed by Columbus. This suggests that the great explorer was in this respect at least fifty years behind the makers of portolan charts — cartographers who, in the very nature of the product of their labors, must have been in intimate contact with mariners of the period.

A third set of data reflecting the length of the degree assumed by European cartographers of the time comes from maps drawn after 1450, when it became common to include coordinate nets with maps using any of a number of projections. On such maps, the angular length of, for instance, the Mediterranean Sea can be read off directly with usually only short interpolation and, since the length of that sea had been well known for more than a thousand years, it is plausible to interpret differences in its angular length as reflections of differences in the length of the degree of longitude. Figure 6 on page 279 shows the results of such determinations on forty-two maps dated from 1450 to 1700 AD. Here again one encounters an unmistakable progression. Before 1500 AD the Mediterranean was represented as nearly 62° long — Ptolemy's value corresponding to an equatorial degree of 74.4 km. Around 1600 AD it had reached the vicinity of modern values of 42°, implying 111km. Here again, too, the progression is a matter of diffuse and gradual rather than abrupt and stepwise change, with values at any given time likely to range over more than 10°. The changes in the length of the degree presumably reflected by these data suggest that in this respect the makers of printed maps were at least 150 years behind the makers of portolan charts.

Figure 6 also includes a single point representing the length of the Mediterranean that would correspond to the length of the degree assumed by Columbus, but in this case its relation to the remainder of the values indicates that he was fifty or more years ahead of the more academically oriented cartographers who produced the printed maps underlying figure 5.

Summary and Discussion

The analysis of Ptolemy's *Cosmographia* produced conclusive evidence for the view that Ptolemy thought in terms of a short degree and a small spherical earth, and that his *stade* was in fact the Greek and not the Roman *stade*. Beyond this, however, the data establish a profound difference between the sources of the longitude and of the latitude data. The latitudes, from an early date on, could be measured on the basis of astronomic observations, the principal kinds of which appear in Ptolemy's work. By contrast, change in longitude as such does not produce any readily discernible changes in the appearance of the earth's surface, the only evidence for change in longitude being linked to the measurement of time. In practice this means that the feasibility of measuring differences in longitude between two localities depends on the development of methods for determining simultaneity in two sites separated by a more or less considerable distance. While in principle the concept of using lunar eclipses for this purpose was recognized since the time of Hipparchus, in practice such measurements were fraught with great difficulty and effectively not available (Ptolemy alludes to a single instance as opposed to at least four hundred astronomically determined latitudes) until the thirteenth or even the sixteenth century. Consequently, longitude differences could only be determined indirectly, on the basis of geodetic measurements converted into angular values by division by whatever length of the degree a given author would select. This meant that the only real sources underlying angular longitude coordinates during this entire period were determinations of the length of the degree of latitude together with the implicit assumption that the earth was a perfect sphere; consequently, the degree of latitude and the degree of longitude were of identical lengths. In the case of Ptolemy, failure to insist on conformity to this assumption led to the paradoxical situation that his astronomically based latitudes agree closely with modern values while his geodetically based longitudes were distorted by an erroneous assumption regarding, ultimately, the length of the degree of latitude — an assumption which, however, he does not have seem to have applied to his own latitude data!

This distinction is of fundamental significance. The historical development of the magnitude of the degree of longitude represents a sophisticated concept of mathematical geography which was not amenable to direct measurement throughout the 1,500 years elapsing between the work of Ptolemy and the enunciation of the method of lunar distances in the sixteenth century.[24] The data presented reveal that while in both the Arabo-Islamic and the western European communities there were changes in the value of this parameter, the patterns

24. J. Werner, *Translation and Commentary on Ptolemy's Geography* (Nürnberg, 1514), ch. 4; cf. also Alonso de Santa Cruz, *The Book of Longitudes*, trans. J. Bankston (Bisbee, AZ, 1992).

these changes followed were profoundly different in the two civilizations. The time frames and the extent of these changes are illustrated by the schematized summary plot of figure 7 on page 279.

In the Muslim world, mathematical geography began with a drastic initial jump under government auspices from Ptolemy's degree of 74.4 km to al-Khwarizmi's 96 km, and probably with additional corrections of numbers of Ptolemean longitudes for individual localities east of the 70th degree. However, no significant further development followed this initial step over the remaining seven hundred years during which one can speak of Arabo-Islamic geography. The majority of the works explored above were extraordinarily self-consistent: linear correlation coefficients for medieval with modern longitudes averaged 0.98. Yet the standard error of individual estimates of the ratio of medieval to modern lengths of the degree average ±7.3 percent. This would seem to be sufficient to account for the greater part of the observed variability in the data for the entire seven-hundred-year period. Nonetheless, the mean value of the length of the degree deduced from this set of data is significantly smaller than the modern value of this parameter ($t=5.6$, $N=32$, $P< 0.001$) but indistinguishable from the length of the Ma'munian degree, and the regression line for the length of the degree upon the date of communication has a slope which is not distinguishable from 0. Thus, the data indicate that, over the entire period from 820 to well after 1500 AD, the degree of longitude retained essentially the value attributed to it on the basis of the Ma'munian measurements.

In the absence of any later repetitions of effective attempts to revise further the length of the degree by direct measurement, any changes in the coordinate tables would have had to depend on the practical experience of travelers, by land or by sea.[25] Yet it is unlikely that professional navigators could have played much of a role in this. The very different levels of understanding among scholars and among navigators of the proper methods for determining latitudes south of the equator (that is, when the Polestar has sunk out of sight) suggest severely deficient communication between these two groups. Again, the curious characteristics of the coordinate data for the Sudan entered into the Paris manuscript of al-Idrisî's *Book of Roger*, most likely by Ibn Sa'id or one of his pupils, illustrate the garbled way in which caravan-derived information entered the body of fact represented by successive writers in the absence of planned and scientifically guided and collated exploratory activity.[26] Under the circumstances, any considerable variability in the length of the degree would have made consistent development toward more nearly correct values on the basis of practical experience exceedingly difficult.

The analysis demonstrated a somewhat different situation for the null meridian used by the medieval Muslim geographers. The data are clustered around three longitudes, spread from the east end of the chain of the Canary Islands to the western end of the Azores, and show little relation to the presumed choice by those authors of null meridians "in the Eternal Isles" or "on the west coast of Africa." More significantly, the frequency distribution of the choices changes rather abruptly around the year 1250 AD to give unmistakable preference to the Azores — of which Muslim sailors were supposed to be ignorant. The early Muslim writers tended to favor the use of Ptolemy's choice in the matter, although, as the figures show, they do not seem to have insisted slavishly on his value corresponding to 12° W. More positive arguments arose in the matter as geographers realized the implications of the relation between Ptolemy's insistence that the inhabited earth stretched over 180° and the difference established between his and the Ma'munian degrees, and as they related all this to traditions regarding the Qubba Arin. These considerations became especially compelling around the beginning of the thirteenth century, and that date fits well with the fact that the year 1250 AD presented something of a boundary between the time when the majority of geographers chose the Canary Islands for their null meridian and the later period when increasingly that line was drawn through the Azores. If this interpretation is correct, it implies that considerations which can only have originated from within the learned community drove the observed change. Thus, there exists a second instance of relatively abrupt change in the interpretation of coordinate data in the medieval Muslim world associated with recognizably "official" determination.

Turning from the Arabs to western Europe, figure 7 shows that here the situation — or our understanding of it — was more complicated. From the very beginning of the resurgence of an interest in orienting themselves

25. al-Biruni, *Kitab al-tahdid*, spoke of the application of spherical trigonometry to the measurement and computation of differences in longitude between localities but did not apply these methods to a renewed determination of the length of the degree of longitude. Furthermore, it seems that the significance of his mathematical concepts failed to be appreciated by succeeding Muslim geographers as well as by European scholars at least until the sixteenth century.

26. R.W. Brauer, "Geography in the Medieval Muslim World: Seeking a Basis for the Comparison of the Development of the Natural Sciences in Different Cultures," *Comparative Civilizations Review* 26 (1992): 73-109.

on the surface of the terrestrial sphere, the Europeans, even while continuing to present a few tables of coordinates in the Ptolemaic-Muslim pattern, preferentially made use of maps and charts to convey quantitative information. This had, of course, been the aim in the days of the Roman and Hellenistic geographers, but with rare exceptions — the lost Ma'munian map and al-Biruni's applications of spherical trigonometry being the main examples — had fallen into disuse among Muslim geographers from the time of the Balkhi school on. The European revival of interest seems to be linked to the introduction of the boxed compass into the practice of navigation in the Mediterranean, probably in the twelfth century. Maritime charts exploiting the possibilities of the new tool probably began to appear in the middle of the thirteenth century. Such charts bear the unmistakable imprint of their link to the magnetic compass in the characteristic skewing of all of these maps before about 1600 AD (when the abandonment of such skewing might have reflected either recognition of the existence of magnetic deviation, or the disappearance of significant magnetic deviation over much of the Mediterranean Sea).[27] Subsequent developments through plain charts to the concern with projections which might serve for truly accurate rhumb line and great circle sailing, and for the representation of an ever larger proportion of the earth's surface in a coherent and quantitatively meaningful way, were the logical extension of the basic attitude revealed in the early portolan charts. All of these sources provide opportunities for comparison and for evaluation of the length of the degree in the light of accumulating experience.

Analysis of this material, as summarized in the schematic figure 7, reveals that, in contrast to the Muslim experience, the passage of time among European geographers and cartographers saw in all media a rapid and progressive lengthening of the degree of longitude toward its modern value. Significantly, too, in all three categories depicted, the European geographers started not from the length of the degree accepted by their Arabo-Islamic peers, but from lengths substantially shorter. Indeed, the printed map series used Ptolemy's short degree, which had been revised at the very outset of Arabo-Islamic mathematical geography. It is clear, then, that in this respect transmission of information between the two civilizations was imperfect, at least at the outset of the revived European interest in the natural sciences.

What is one to say of the subsequent development of this concept in the western world? Surely, by 1250 AD the West felt the Muslim influence, and some Muslim authors, such as al-Farghani, (called Alfragani),[28] Ibn Yunus,[29] and al-Khwarizmî,[30] were quoted and might have encouraged some of the earlier revision of the length of the degree. There is also evidence of sustained maritime exploratory activity, extending rapidly beyond the confines of the Mediterranean Sea into the Atlantic Ocean, and there is also, from at least the eleventh century on, substantial exploration toward the East, manifest in such travels as those of Friar Rubruk[31] or the Polos.[32] Together these laid the groundwork for the explosive development of geographical knowledge and nautical science of the sixteenth and seventeenth centuries. In the meantime, these many voyages, especially those systematically coordinated under the Portuguese monarchs, produced an ever increasing background of knowledge held by those actually involved in the acquisition of those data, but inevitably diffusing out to those most in need of it — mariners and the cartographers serving them as well as recording their exploits. An important component of this development was the emergence of places where the accruing information was gathered for the benefit of future cartographers and mariners — places such as Mallorca or, presumably, Sagres.

Any model intended to describe the development of European mathematical geography insofar as it expresses itself in a knowledge of the size of the earth must reckon with the extraordinarily diffuse character of these changes. Such development as there was could not have taken its origin from among the academic scholars — the cosmographers — such as those who in the late fifteenth century confronted Columbus with contorted reflections of scholastic musings on Aristotle's views of what the earth must be like.[33] Rather, change would seem to have occurred as the accumulating experience of the men of practice — the navigators and the shipmen — slowly penetrated the consciousness of those seeking to fashion meaningful and therefore useful images of the world about them. In particular, there is evidence that the experience of Portuguese mariners working their way down the West African coast in the late fourteenth and fifteenth centuries influenced chartmakers by casting doubt on the traditional length of

27. Tanguy, et al., "Geomagnetic Secular Variation in Sicily."

28. Abû 'abas ahmad ibn muhammad al-Farghanî, *Elementa asronomica arabicè et latinè*, ed. and trans. J. Golus (Amsterdam, 1669).

29. Caussin de Perceval, *Le livre de la grande table Hakémite* (Paris, 1804).

30. von-Mzik, *Das Kitâb Surat*.

31. W. de Rubruk, *Putechestview v vostochniye strany*, ed. and trans. N.P. Shastina (Moscow, 1957).

32. Rusticiano de Pisa, *Le liver de Marco Polo, citoyen de Venise*, ed. M.G. Pauthier (Paris, 1865).

33. Randles, "The Evaluation of Columbus' India Project."

the degree.[34] It is clear that, at the time, any disagreement between linear distance estimates and astronomically determined position could only have referred to the degree of latitude. Indeed, it was fortunate for such development that the actual course along the coast on the way down, and the loop over the open Atlantic on the way back, comprised such important components of N-S displacement. At the time, neither the means of estimating ship speed, (as well as, probably, compass course) nor of resolving an oblique course into its orthogonal coordinates on a spherical surface were available that could have allowed the comparison to be made except along a largely N-S course.

The process thus had the characteristics of a constrained random change, as is perhaps inevitable as long as the parameter under discussion was universally admitted to be of overreaching importance but yet effectively immune from actual measurement. By the time measurement became practicable at the turn of the sixteenth century, the greater part of such change had been accomplished in the European community. The remarkable lag in the incorporation of this knowledge into the printed maps of the sixteenth and seventeenth centuries merely serves to underscore the somewhat random character of the penetration of existing knowledge into the learned community of late medieval and Renaissance Europe.

Figure 7 includes a point which represents the position on that plot of the length of the degree that Columbus accepted on the basis of Pierre d'Ailly's *Imago Mundi*. His copy contains 620 marginal notes in his own hand.[35] This illustrates most vividly that Columbus in this respect, too, stood between two worlds: the still unreconstructed world of the scholars whose dicta were paramount in the minds of the makers of printed maps, and the world of the makers of charts for mariners who of necessity sought to benefit to the greatest extent possible from the experience of their clients. This observation speaks eloquently in refutation of those who reproach Columbus because of his largely self-acquired rather than officially certified learning. His position was a remarkably reasonable compromise; if one were to criticize, it ought to be on the grounds that he gave too much weight to authority and erudition and perhaps too little to practical experience, knowledge of which he might have gained from closer contact with the mariners whose data were being accumulated at Sagres and Lisbon. The observation seems a fitting example of the devious processes of transmittal of knowledge in the late Middle Ages that have lent a curiously diffuse character to the development of knowledge concerning the length of the degree of longitude in the days before that parameter could be measured directly.

34. A.F. da Costa, *A ciencia nautica dos Portugueses na epoca dos descobrimentos* (Lisboa, 1958), 77-78.

35. D'Ailly, *Ymago Mundi* (trans. E. Buron).

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Table 1
Ptolemy's Longitude Parameters

	Length of degr.-km	Length of stade-km	Null meridian*
Cosmographia	74.4±2.4	0.149	12.5±1.2
Modern	111.3	-	0

*°W of Greenwich

Table 2
Comparison of Equatorial and Meridianal Diameters of Earth

Name	n	alfa lon ± se*	alfa lat ± se*	diam mer	diam eq	ratio diam
Ptolemy	19	0.67±0.02	0.92±0.05	11,702	8,522	1.37
Modern	-	1.00	1.00	12,713	12,756	0.997

*Slopes of regression lines for longitude and for latitude respectively in plot of modern vs. Ptolemean values.

Table 3
Length of Mediterranean Sea - Ptolemy Compared to Modern Data

Source	no. of degrees	km/°	km length of med.
Cosmographia	62	74.4	3732
Modern	42	111.3	3799

Table 4
Correlation between Ptolemy's Cosmography and al-Khwarizmi Coordinates

Parameter	Range	Correlation Coefficient	Regression Coefficient
longitude	0-118°	0.97	0.80±0.02
"	<70°	0.99	0.88±0.03
"	>70	0.94	0.73±0.04
latitude	0-73°	0.98	0.98±0.02
"	<40°	0.99	0.95±0.02
"	>40°	0.93	1.01±0.11

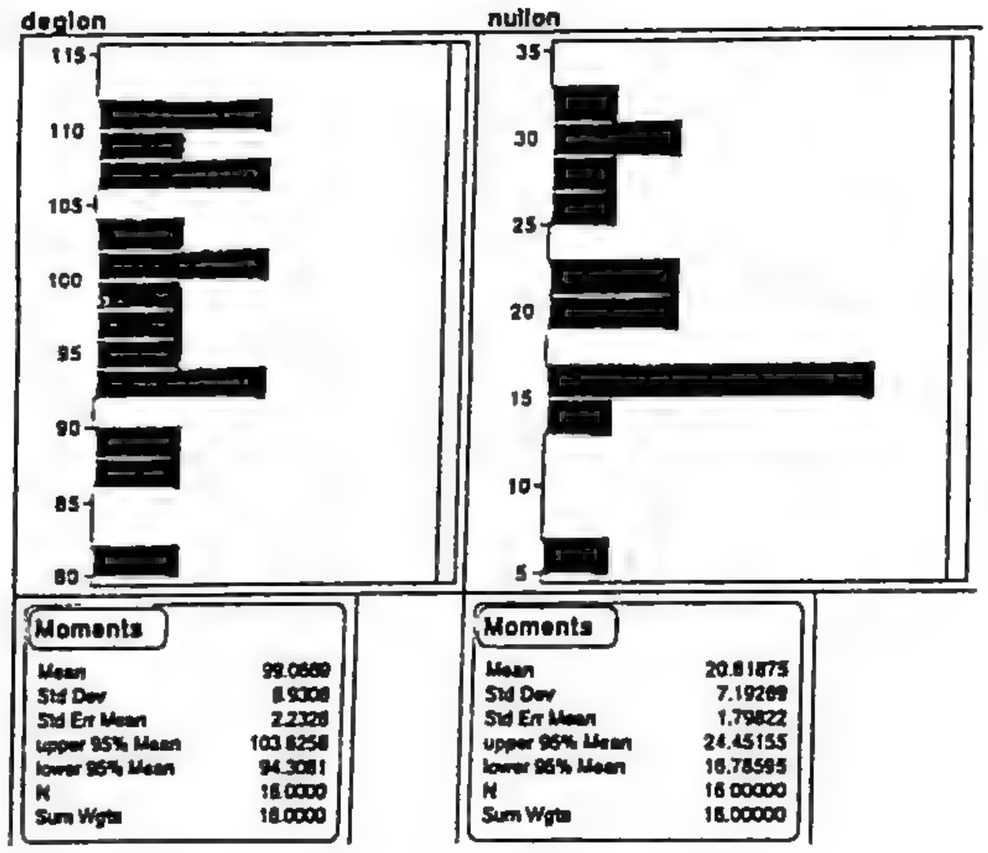

Figure 1: Frequency distribution of length of the degree of longitude (deglon) and of the longitude of the prime meridian (nullon) in the writings of thirty-two Arabo-Islamic geographers writing between 820 and 1580 AD.

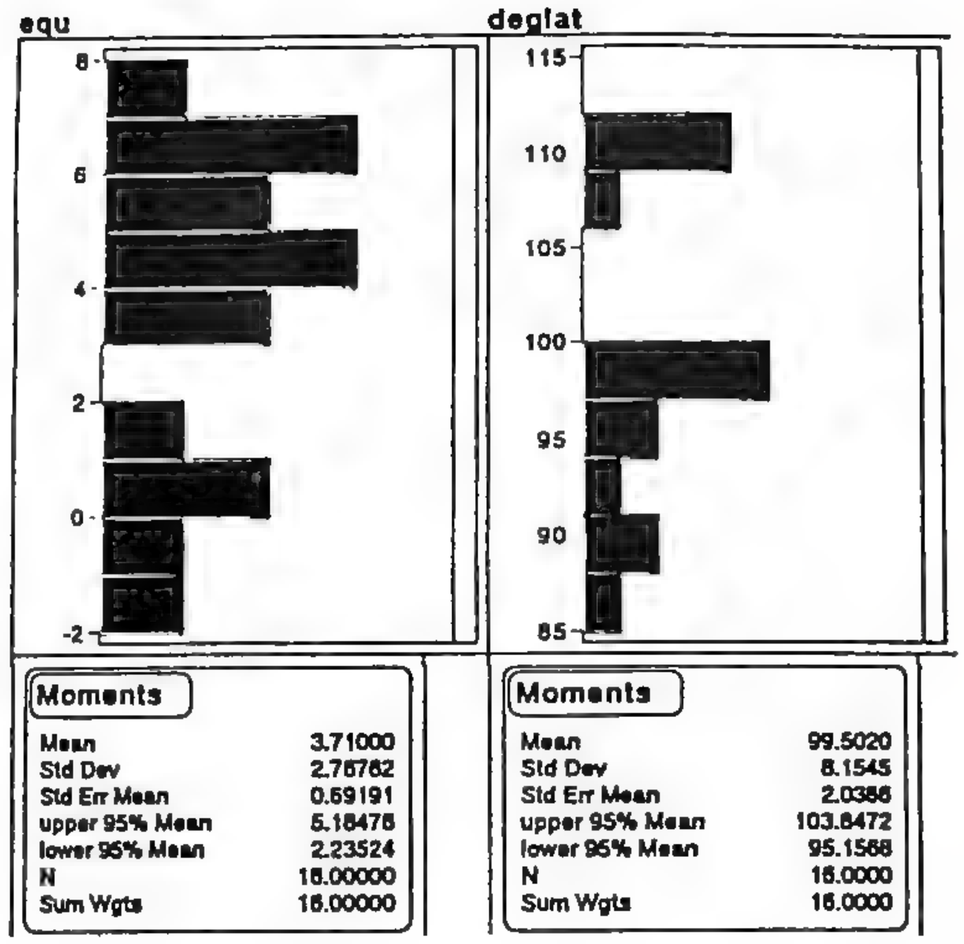

Figure 2: Frequency distributions of the length of the degree of latitude (deglat) and of the latitude of the equator (equ) in the writings of sixteen Arabo-Islamic geographers writing between 820 and 1450 AD.

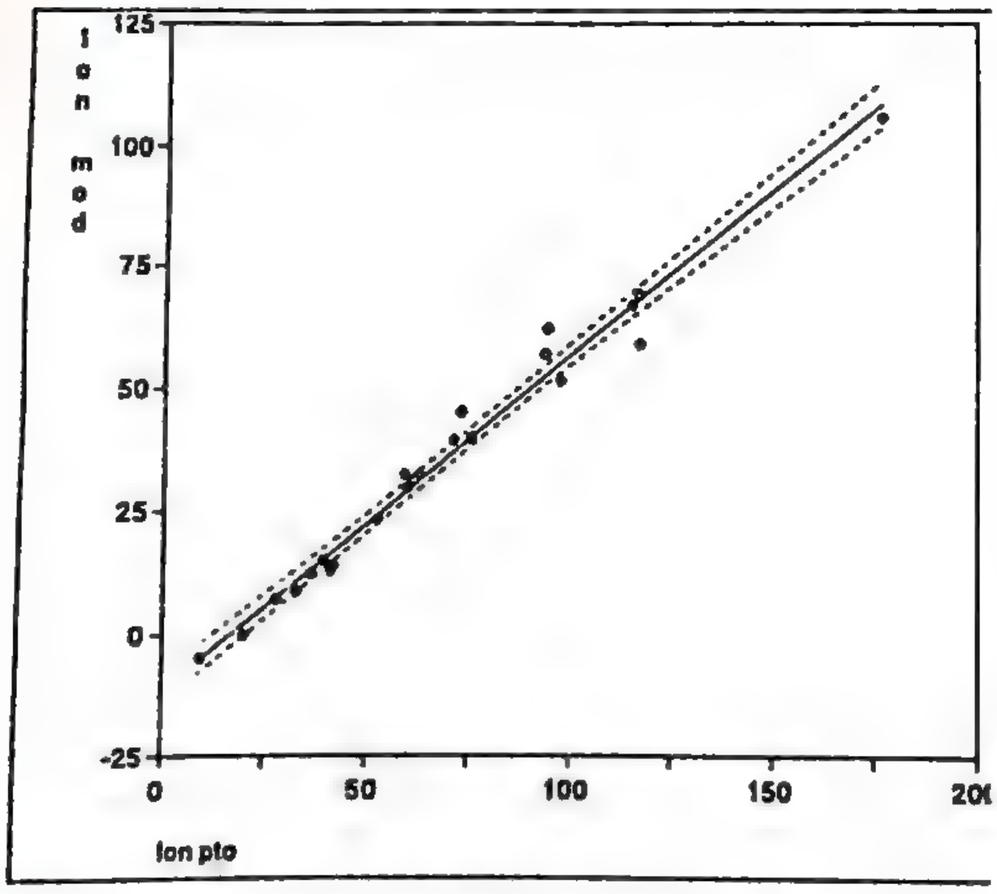

Figure 3: Comparison of the longitudes for twenty-six localities as given in Ptolemy's *Cosmographia* (lon pto) with modern longitudes for the same place (lon mod). The solid line is the least square regression line computed for these values.

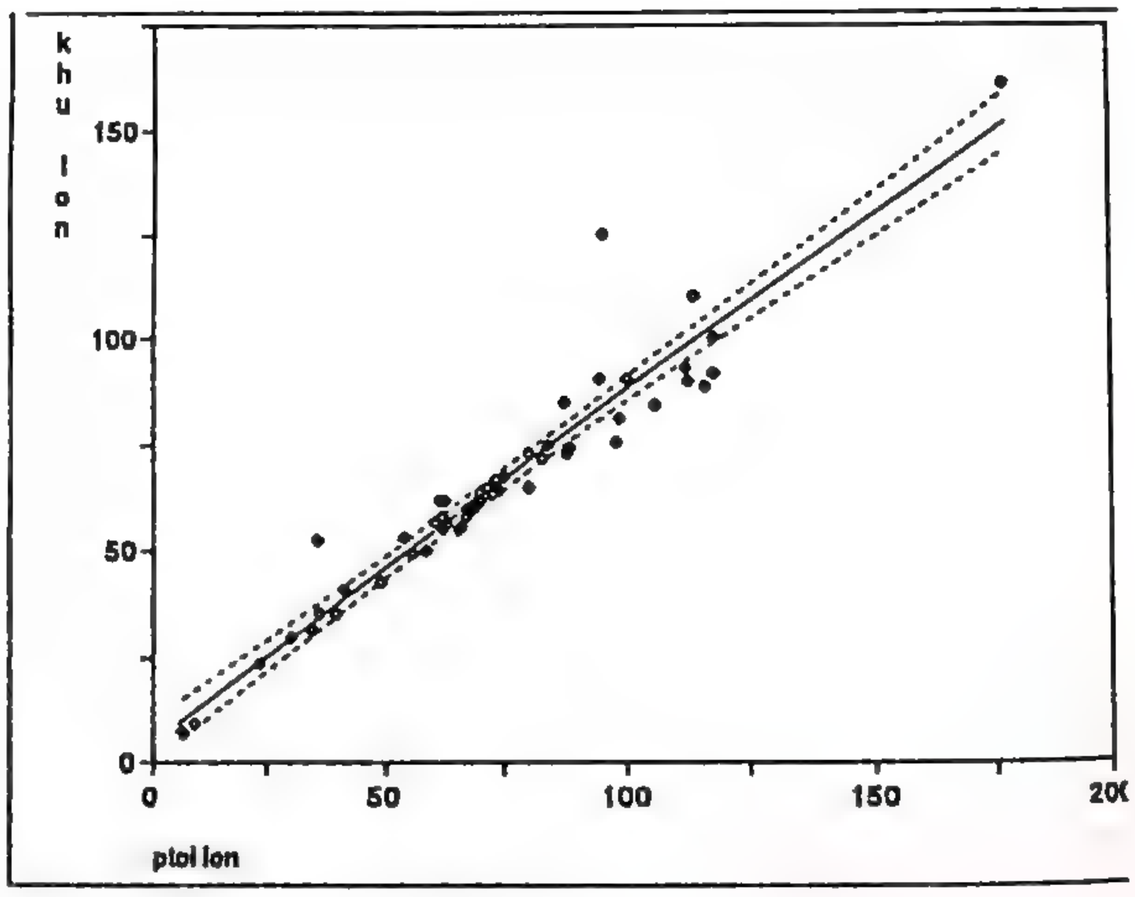

Figure 4: Comparison of the longitudes of forty-one localities as listed in Ptolemy's *Cosmographia* with longitude values for the same localities in al-Khwarizmî's *Kitâb sûrat al-'ardh*. The solid line is the regression line for all values.

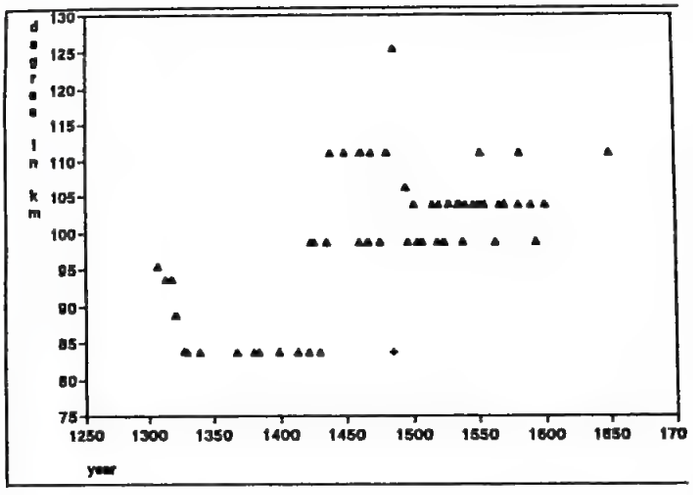

Figure 5. Length of the degree of longitude as implied by 86 portulan charts (data from reference [24]) plotted as a function of the most likely date of the chart. X = the value accepted by Columbus.

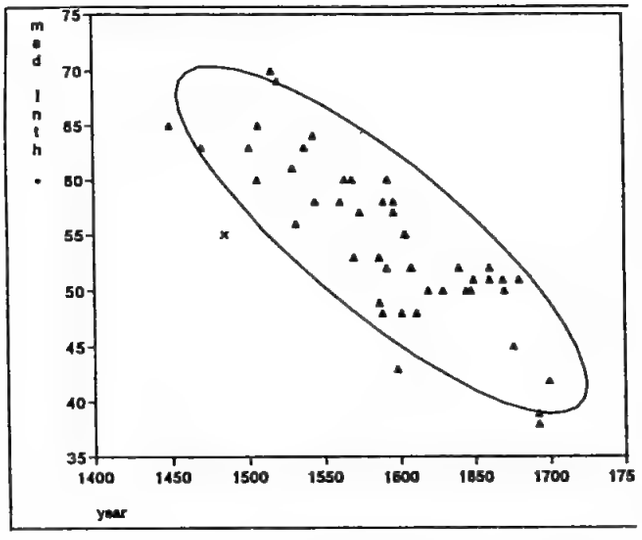

Figure 6. Angular length of the Mediterranean Sea as shown in forty-four printed maps from the fifteenth to eighteenth century. The density elipse is drawn for inclusion of 90 percent of the values; the probability that these two variables are not correlated is less the 1 percent. X = the value corresponding to the length of the degree of longitude accepted by Columbus.

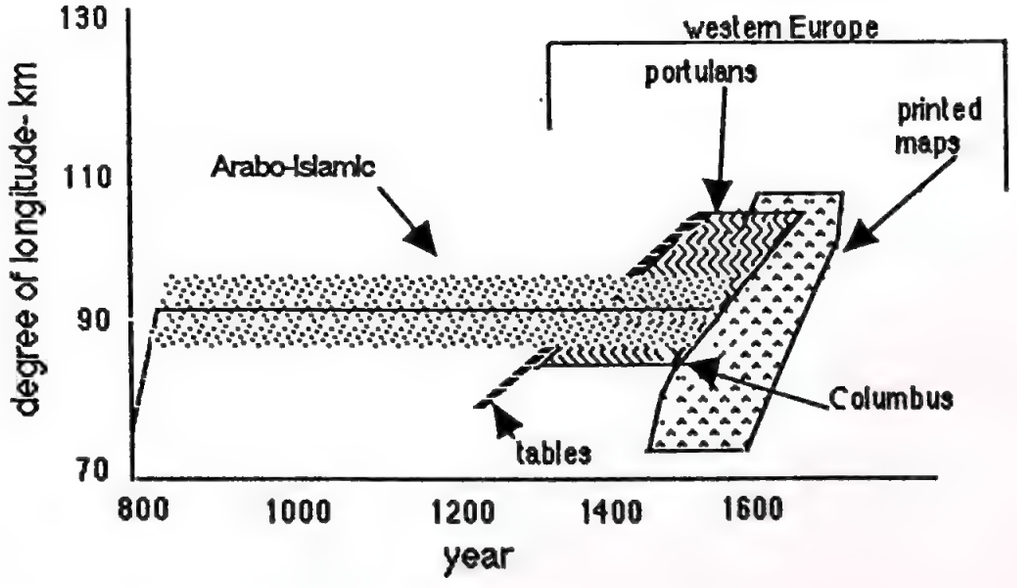

Figure 7. Summary diagram showing the evolution of the length of the degree of longitude in the Arabo-Islamic and the Western European orbits.

Christopher Columbus and the Piri Reis Map of 1513

GREGORY C. MCINTOSH

The famous Ottoman admiral known as Piri Reis was born Muhiddin Piri in Gallipoli about 1465. At the age of twelve, he joined the crew of his famous uncle, Admiral Kemal Reis, a corsair or privateer. Under the tutelage of his uncle for fourteen years, Piri spent six of those years (1487-93) sailing along the coasts of North Africa and the western Mediterranean, transporting the Moslem population in Granada from Spain to North Africa. Piri wrote that during this time ". . . we sailed on the Mediterranean and fought the enemies of our religion mercilessly."[1] Against the Venetians in 1499-1502, Piri commanded his own ship in a fleet commanded by his uncle Kemal Reis, the Kapudane or Supreme Admiral.

In 1513, Piri Reis completed the first of his two world maps. Throughout his naval career, he made notes and sketched maps of the islands and coastlines he visited. In later years, he collected his navigation and maritime notes into book form. In 1523, the Ottoman Grand Vizier Ibrahim Pasha learned of these notes and maps and, realizing their value to other Turkish sailors and to the Ottoman Empire, he encouraged Piri Reis to assemble them into a book. This book is known as *Kitab-i Bahriye*, that is "Naval Book" or "Book of Maritime Matters."[2] In 1526, Piri presented his revised, second edition of the *Bahriye* to Sultan Süleyman the Magnificent. Two years later, he made another world map, which he also presented to the Sultan.

In 1554, when he was almost ninety years old, Piri Reis was beheaded by the sultan following his defeat in a sea battle with the Portuguese. The treasure he had accumulated during his many decades of pirating with Kemal Reis and service in the Turkish navy was taken to the Topkapi Serai Palace in Istanbul.

Although a great name in Turkish naval history, Piri Reis is perhaps best known for his world maps and the *Bahriye*. This book was not printed until the twentieth century, but it was important to the Turkish navy; more than two dozen sixteenth-century manuscript copies still exist today. The introduction of the second edition, written in verse, gives information on all aspects of navigation and maritime matters. The main body of the book contains over two hundred maps and charts and gives detailed descriptions of all the islands, coasts, and ports of the Mediterranean Sea. It also describes the Atlantic Ocean and the new continent on its western shore found by Spanish sailors.

THE PIRI REIS MAP OF 1513

Although copies of Piri Reis's maps exist today, no map made by or under the supervision of Christopher Columbus has survived the passage of time.[3] As

1. The best sources for the life of Piri Reis are A. Afetinan, *Piri Reis'in Amerika Haritasi (1513-1528)* (Ankara: Türk Tarih Kurumu Basimevi, 1954), 6-25; Yusuf Akçura, "Turkish Interest in America in 1513: Piri Reis's Chart of the Atlantic," *Illustrated London News*, 23 July 1932, 142; Mert Bayat, Foreword to *Kitab-i Bahriye* by Piri Reis, 4 vols. (Istanbul: The Historical Research Foundation, 1988), 1: 16-18. The quotation is from A. Afetinan, *Life and Works of Piri Reis*, trans. Leman Yolaç and Engin Uzmen (Ankara: Turkish Historical Association, 1975), 9.

2. Basic studies of the *Bahriye* include Paul Kahle, *Piri Re'Is Bahrije, Das türkische Segelhandbuch für das Mittelländische Meer vom Jahre 1521*, 2 vols. (Berlin and Leipzig, 1926) and "Piri Reis und seine Bahrije," in *Beitrage zur historischen Geographie, Kulturgeographie, Ethnographie und Kartographie, vornehmlich des Orients ... herausgeg*, ed. Hans Mžik (Leipzig and Vienna, 1929); Piri Reis *Kitab-i Bahriye*, facs. ed. of 1526 manuscript, Turkish Historical Society Publication no. 2 (Istanbul: Turk Tarih Kurumu, 1935); *Kitab-i Bahriye*, facs. ed. of 1526 manuscript, ed. Ertuğrul Zekâi Ökte, 4 vols. (Istanbul: The Historical Research Foundation, 1988); and Svat Souchek, "A propos du livre d'instructions nautiques de Piri Re'is," *Revue des Études Islamiques* 41, no. 2 (1973): 241-255. The latter cites many references to the *Bahriye* in the works of others, both European and Turkish.

3. Some of the surviving maps that have been associated with Columbus are the two Martellus world maps of c. 1489 (Arthur Davies, "Behaim, Martellus, and Columbus," *Geographical Journal* 143 [1977]: 451-59); the so-called "Christopher Columbus Chart" (or "Paris Map") of c. 1492 in the Bibliothèque Nationale (Charles de La Roncière, *La Carte de Christophe Colomb* [Paris: Éditions Historiques and Édouard Champion, 1924]; Kenneth Nebenzahl, *Atlas of Columbus and the Great Discoveries* [Chicago: Rand McNally, 1990], 22-25; Michel Mollat du Jourdin and Monique de La Roncière with Marie-Madelaine Azard, Isabelle Raynaud-Nguyen and Marie-Antoinette Vannereau, *Sea Charts of the Early Explorers, 13th to 17th Century*, trans. L. le R. Dethan [New York: Thames and Hudson, 1984], 211-12; Emerson D. Fite and Archibald Freeman, *A Book of*

Figure 1

geographical knowledge increased, older and less accurate maps were discarded, even maps from the hand of Columbus, their historical value not being recognized. The Piri Reis map of 1513 does, however, preserve within its delineation of the West Indies a copy of a map by Columbus.

This beautiful portolan chart (see figure 1 on page 281), discovered in 1929 while the Topkapi Serai was being converted from a palace to a museum, comprises most of the western portion of a larger world map, the remainder having been lost. It depicts the Atlantic Ocean with its islands and coastlines and many ships, animals, and inscriptions in Arabic script. The language of the inscriptions is Osmanli (Ottoman-Turkish).

Fortunately, the portion of the map that has survived includes the New World. The right side of the map clearly shows the coastlines of the Iberian Peninsula, the bulge of West Africa, the Azores, Madeira, the Canary Islands, and the Cape Verde Islands. On the left side of the map are the coastline and bulge of South America, the Lesser Antilles, Puerto Rico, and, in the extreme northwest corner of the map, a jumbled and somewhat unrecognizable depiction of Hispaniola, Cuba, and the Bahamas.

The longest inscription on the map, No. 5, fills the interior of South America and gives a detailed account of Columbus and his voyages. (See map on page 294 for numbers which identify the inscriptions. Translations of the inscriptions are in the appendix on pp. 291-93.) In Inscription No. 6, Piri Reis states that he used about twenty different maps in compiling his world map.[4] He used medieval *mappa-mundi*, Arabic maps, eight Ptolemaic maps, four Portuguese maps, and one of the western regions made by "a Genoese infidel, his name was *Qulūnbū* [Colonbo]."[5] Thus, a copy of a map made by Columbus or under his supervision in 1495 or 1496 survives in the depiction of the West Indies on the Piri Reis map of 1513.

Because it incorporates a map made by Columbus, the Piri Reis map is the only map known to have preserved Columbus's geographical and cartographical ideas. This Columbian cartography is even more rudimentary and more primitive than that of the celebrated Juan de la Cosa map of 1500. Many studies of the Juan de la Cosa map have been made since its discovery in 1832,[6] and the prevailing judgment is that the map is a copy made between 1502 and 1510 of a lost original drawn in 1500. The copy of Columbus's 1495-96 map, preserved in the Piri Reis map of 1513, is thus older than the original of the La Cosa map of 1500, and as such, the Piri Reis map of 1513 is actually the earliest cartographic record of the voyages of Christopher Columbus.[7]

Old Maps Delineating American History from the Earliest Days down to the Close of the Revolutionary War [Cambridge: Harvard University Press, 1926, repr. New York: Dover Publications, 1969], 7-8; and Helen Wallis, "Is the Paris Map the Long-sought Chart of Christopher Columbus?" *The Map Collector* 58 [Spring 1992]: 20-21); the Alba sketch-map of Hispaniola (Robert H. Fuson, *The Log of Christopher Columbus* [Camden, ME: International Marine Publishing Company, 1987], 9; and R.A. Skelton, *Explorers' Maps* [1958, repr. London: Spring Books, 1970], 70); the Juan de la Cosa planisphere of 1500 (Donald L. McGuirk, Jr., "The Juan de la Cosa Theory of Columbus's First Landfall," paper presented at the Annual Meeting of the Society for the History of Discoveries, 14 October 1989, University of Minnesota, Minneapolis); and the Turin map of c. 1523 (Henry Harrisse, *The Discovery of North America* [London and Paris, 1892, repr. Amsterdam: N. Israel, 1969], 530).

4. There appears to be some question among the published studies of this map as to whether the twenty charts and *mappamundi* included the eight *Jaferiyes (jografyas)* and the four Portuguese maps also mentioned. A. Afetinan, *The Oldest Map of America, Drawn by Piri Reis*, trans. Leman Yolaç (Ankara: Türk Tarih Kurumu Basimevi, 1954), 24, 31; Yusuf Akçura, *Piri Reis Haritasi*, 2d. ed. (Istanbul: Seyirve Hidrografi Dairesi, 1966, repr. of 1935 edition), 21; and Paul Kahle, "A Lost Map of Columbus," *Geographical Review* 23, no. 4 (October 1933): 624, and "Piri Re'is - The Turkish Sailor and Cartographer," *Journal of the Pakistan Historical Society* 4, no. 2 (April 1956): 106, each give a total of twenty maps. Esin Atil, *The Age of Sultan Süleyman the Magnificent* (New York: Harry Abrams, Inc., 1987), 78, gives the total as thirty maps. Afetinan, *Life and Works*, 27-28; Sevim Tekeli, "The Map of America by Piri Reis," *Erdem* 1, no. 3 (1985): 677); M. Yerci, "The Accuracy of the First World Map Drawn by Piri Reis," *The Cartographic Journal* 26, no. 2 (1989): 154, and Bayat, Foreword to *Kitab-i Bahriye* 1: 20-21, add the eight *Jaferiyes* and the four Portuguese maps to the twenty for a total of thirty-two maps.

5. Transliteration of the name according to Dr. Paul Chevedden, personal communication. The name has also been rendered into modern Roman letters as *Qul nb* (Dr. Thomas Goodrich, personal communication); *Colon-bo* (Paul Kahle, *Die verschollene Columbus-Karte von 1498 in einer türkischen Weltkarte von 1513* [Berlin and Leipzig: Walter de Gruyter and Company, 1933], 624); *Colonbo* (Kahle, "Un mapa de América hecho por el turco Piri Re'is, en el año 1513, basándose en un mapa de Colón y en mapas portugueses," *Investigación y Progreso* 5, no. 12 [1 December 1931]: 170, and Akçura, *Piri Reis Haritasi*, 23); and *Kolonbo* (Kahle, "Die verschollene Columbus-Karte von Amerika vom Jahre 1498 in einer türkischen Weltkarte von 1513," *Forschungen und Fortschritte* 8 [1932]: 248). In the *Bahriye*, Piri Reis refers to him as *Kolon*, the Spanish form of the name, instead of *Qulānbū*, i.e., Colonbo or Colombo, the Italian form. See Paul Lunde, "Piri Reis and the Columbus Map," *Aramco World* 43, no. 3 (May-June 1992), 25; Piri Reis, *Kitab-i Bahriye* (1988), 1: 195.

6. Nebenzahl, *Atlas of Columbus*, 30, discusses the basic studies of the La Cosa map, but see also George E. Nunn, *Geographical Conceptions of Columbus: A Critical Consideration of Four Problems* (1924, repr. Milwaukee: The American Geographical Collections of the Golda Meir Library, University of Wisconsin - Milwaukee, 1992); E. Roukema, "Some Remarks on the La Cosa Map," *Imago Mundi* 14 (1959): 38-54; and McGuirk, "Juan de la Cosa Theory."

7. See Nebenzahl, *Atlas of Columbus*, 30.

THE "COLUMBUS" INSCRIPTION

Inscription No. 5 on the Piri Reis map relates the history of Columbus up to 1492, followed by the narrative of a Spanish slave or prisoner. The events are told as though they all occurred on the first voyage, but this inscription actually contains information from four different Spanish voyages to the New World. Most of the events described are from Columbus's second voyage and differ from the records of his voyages.[8] For instance, the men and women attacking the Spaniards with fishbone-tipped arrows and the first encounters with the Caribs, who "went from island to island hunting men and eating them," occurred on the second voyage.[9] The North Star becoming "veiled and invisible," that is, lost to sight near the equator, did not occur on any of Columbus's voyages because he did not sail further south than about 10° N. This phenomenon was first observed on a voyage to the New World during Vicente Yáñez Pinzón's voyage to Brazil in 1499-1500.[10] The inscription also says that "they saw pearls in the hands of a person," and that "they saw that when they gave beads many more pearls were brought to them." Columbus had pearls with him on his first voyage, but only found pearls on his second voyage and traded beads for pearls on the third voyage.[11] Thus, the Spanish prisoner's narrative combines events from Columbus's first three voyages.

The inscription states that Columbus discovered the western coasts in the year AH 896, or 1490 AD. Disagreement on the year of Columbus's discovery was not uncommon in the sixteenth century. In fact, sixteenth- and seventeenth-century works give dates ranging from 1490 to 1497.

The inscription also relates that Kemal Reis, the uncle of Piri Reis, obtained this Columbus map from a Spanish prisoner-of-war or slave who said he had been with Columbus to the new lands across the Western Sea three times. In the *Bahriye*, Piri Reis describes how he and his uncle captured some Spanish ships that contained headdresses made of parrot fur (feathers?) and a hard, black stone that could cut iron.[12] These same objects are described in Inscription No. 3 on the Piri Reis map. Presumably, it was upon the occasion of this sea battle, probably near Valencia in 1501,[13] that the Spanish slave and the map of Columbus came into the hands of Kemal Reis.[14] That a common sailor would possess a map by Columbus is questionable; this Spanish prisoner was perhaps a naval officer or a pilot.[15]

The inscription states that Columbus learned of the western lands, rich with precious metals and gems, from a book. This may have been the *Imago Mundi* of Pierre d'Ailly, the *Historia Rerum Ubique Gestarum* of Aeneas Sylvius Piccolomini (Pope Pius II), or *Marcus Paulus (Travels of Marco Polo)*, all books that influenced Columbus's plan of sailing west to reach the East. Also, Martín Alonso Pinzón, captain of the *Pinta* and second in command to Columbus on the first voyage, had read an old document while in Rome on business prior to 1492 that told of a mythical expedition which sailed west to Cipango (Japan), and this inspired him to propose such an expedition.[16]

The statement that Columbus first proposed his plan to the leaders of Genoa, his native city, confirms what several sixteenth-century chroniclers recorded.[17] The inscription further states that the Bey, or king, of Spain gave two ships to Columbus. There were, of course, three ships on the first voyage, but only two returned, the *Santa Maria* being wrecked on reefs on the north coast of Hispaniola, and this may account for the discrepancy.[18] In addition, the inscription states that

8. Samuel Eliot Morison, *The Second Voyage of Christopher Columbus* (Oxford: Oxford University Press, 1939), 16-17.

9. _____, *Journals and Other Documents on the Life and Voyages of Christopher Columbus* (New York: The Heritage Press, 1963), 211-12, 235-38.

10. Roukema, "Remarks on the la Cosa Map," 45. The Portuguese knew about the disappearance of the North Star when sailing south of the equator, of course, from their voyages down the coast of Africa in the fifteenth century.

11. Oliver Dunn and James E. Kelley, Jr., *The* Diario *of Christopher Columbus's First Voyage to America 1492-1493* (Norman, OK: University of Oklahoma Press, 1989), 133; Cecil Jane, *The Four Voyages of Columbus*, repr. of *Select documents Illustrating the Four Voyages of Columbus*, 2 vols. (1930-33, repr. New York: Dover Publications, 1988), 1: 147-48; Morison, *Journals and Other Documents*, 273.

12. Paul Kahle, "A Lost Map of Columbus," 626, nn. 9 and 10, 627, n. 9; and Piri Reis, *Kitab-i Bahriye* (1988), 1: 191, 197.

13. Hans Albrecht von Burski, "Kemal Re'is: Ein Beitrag zur Geschichte der türkischen Flotte" (Ph.D. diss., University of Bonn, 1928), 60.

14. Kahle, "A Lost Map of Columbus," 626. Curiously, R.A. Skelton, in his appendix, "The Cartography of Columbus's First Voyage," in Cecil Jane, trans., *The Journal of Christopher Columbus* (1930, repr. New York: Bramhall House, 1960), 223, states that the Columbus source map was obtained in 1497 from an Italian prisoner.

15. Roberto Almagià, "Piri Re'is' World Map and the Columbus Chart of 1498," *The Hydrographic Review* 11, no. 2 (November 1934): 194; Charles H. Cotter, "Piri Reis: Admiral Extraordinary," *The Journal of Navigation* 25, no. 2 (April 1972): 249.

16. Harrisse, *Discovery of North America*, 388-90; Samuel Eliot Morison, *Admiral of the Ocean Sea* (Boston: Little, Brown, and Company, 1942), 137.

17. Kahle, "Lost Map of Columbus," 626; Paulo Emilio Taviani, *Christopher Columbus: The Grand Design*, trans. William Weaver (London: Orbis Publishing Ltd., 1985), 491-93. John Fiske, *The Discovery of America*, 2 vols. (Boston: Houghton, Mifflin and Company, 1892), 1: 399-400, relates a rumor that Columbus also proposed the "enterprise" to Venice.

18. Justiniani recorded early in the sixteenth century that the

when leaving Spain, the fleet first reached the Strait of Gibraltar, but this conflicts with the facts because all of Columbus's expeditions sailed from Atlantic ports in Spain (Palos, Cadiz, and Seville) and did not sail through the Straits from the Mediterranean to the Atlantic.

Europe, Africa, and the Atlantic Islands

The surviving portion of the 1513 world map of Piri Reis shows both sides of the Atlantic Ocean from the Bay of Biscay southward. The depiction of Europe contains some identifiable placenames: *Brest* (the northwestern peninsula of France), *Biladi Ispanye* (Spain), *Galiziya memleketi* (Galicia), *Baskin* (Basque country?), *Tahti Portakal* and *Portukal kenari* (Portugal), *Lizbon* (Lisbon), and *Kunata* (Granada).

In West Africa the map shows cities, rivers, lakes, animals, seated figures, and mountains that are the same as those shown on other earlier portolan charts.[19] Along the coast of the bulge of West Africa and in the interior are many placenames commonly found on fifteenth- and sixteenth-century maps, some of which continue in use today. For example, *Akburun* is the Turkish translation of "White Cape" or Cabo Blanco. *Yeşil burun* is Turkish for "Green Cape" or Cabo Verde, i.e., Cape Verde. *Altun irmağı* is the "Golden River," i.e., the Rio de Oro of West Africa on medieval maps.

Inscription No. 14 relates a famous event in the medieval tale of the legendary voyage of St. Brendan in which he and his sailing brethren mistook a whale for an island, landed upon it, and lit a fire. The whale then plunged into the sea and the voyaging Irish monks fled to their ships. The whale and two persons seated upon it with a ship nearby appear in the North Atlantic Ocean on the Piri Reis map. In this inscription Piri Reis says this event is not from one of the Portuguese maps but from the medieval *mappamundi* he used. Medieval *mappamundi* were often oriented with south to the top, and this may be why the depiction of St. Brendan and the whale is "upside-down" on the Piri Reis map.[20]

To the west of Europe in the North Atlantic and to the west of Africa in the South Atlantic are two league scales set at angles. The league scale was a common feature of sixteenth-century Portuguese maps, and the presence of league scales in mid-ocean set at angles appears to confirm the Portuguese origin of some of the source maps used by Piri Reis, as he states in Inscription No. 6.

Inscription No. 13, located next to the Azores, reads: "And a Genoese barque coming from Flanders was caught in a storm. Impelled by the storm it came upon these islands, and in this way these islands became known." While some believed that the Genoese discovered the Azores in the fourteenth century, others believed that a Fleming named Van der Berg was driven by a storm to these islands in 1432 and that the Portuguese followed up on the discovery. Because of the familial connections between the rulers of Portugal and Burgundy, which ruled Flanders, the Flemish became early settlers in the Azores along with the Portuguese, and the islands were called the "Flemish Islands."[21]

It is interesting that six map inscriptions give storms as the cause for the discoveries of the Azores, one of the Cape Verde Islands, the Isle of Vaca, and two regions in South America. In fact, the only accidental discoveries (or rediscoveries, all by Portuguese) attributed to storms on either side of the Atlantic south of the Strait of Gibraltar were Madiera in 1419, the Cape Verde Islands in 1454, and Brazil in 1500.[22]

Inscription No. 21, next to a depiction of a lateen-rigged ship and the Cape Verde Islands, reads: "The master of this caravel is called Messire Anton the Genoese, but he was brought up in Portugal. One day this caravel encountered a storm, and was driven upon this island. He (the master) found much ginger here and wrote about these islands." Undoubtedly, this "Messire Anton" is Antonio da Noli (or de Nolle) who was employed in the service of Infante Dom Henrique (Prince Henry the Navigator) and began the colonization of the Cape Verde Islands in 1460.[23] Though he was not

king of Spain ordered two ships to be fitted out for Columbus. See Henry Harrisse, *Notes on Columbus* (New York: privately printed, 1866), 75. Sebastian Münster made the same error regarding the number of ships on Columbus's first voyage in the Fifth Book of his *Cosmographiae universalis* of 1550. See Richard Eden, *A Treatyse of the Newe India*, (1553, repr. London, 1966), 5v, unpaginated).

19. Examples include a chart by Angelino Dulcert of 1339, the Catalan Atlas of c. 1375, and a 1424 chart by Mecia de Viladestes. These three charts are illustrated in Mollat de Jourdin and La Roncière, *Sea Charts of the Early Explorers*, pl. 7, 8, 12.

20. William H. Babcock, *Legendary Islands of the Atlantic*, American Geographical Research Series, no. 8 (New York: American Geographical Society, 1922, repr. Plainview, NY: Books for Libraries Press, 1975), 36; Fridtjof Nansen, *In Northern Mists*, trans. Arthur G. Chater, 2 vols. (London: William Heinemann, 1911), 1: 344 and 363, 2: 234.

21. Samuel Eliot Morison, *Portuguese Voyages to America in the Fifteenth Century*, Harvard Historical Monographs no. 14 (Cambridge, Harvard University Press, 1940), 15, 44; *Encyclopaedia Britannica* (1955), s.v. "Azores."

22. See Taviani, *Grand Design*, 363 (for Madeira), 74, 310 (for Cape Verde Islands), and Washington Irving, *The History of the Life and Voyages of Christopher Columbus* (1827-28, repr. London: Henry G. Bohn, 1850), 464 (for Brazil).

23. See Adnan-Adivar, *La Science chez les Turcs Ottoman*, 76-77. Charles de La Roncière, apparently unaware of the traditional

the first discoverer of the Cape Verde Islands, they were called the "Isles of Antonio" and da Noli was given such credit on sixteenth-century maps such as the Juan de la Cosa map of 1500 and the so-called "Christopher Columbus Chart" (or Paris Map) of c. 1492.

South America

The delineation of South America and the names upon it indicate that Piri Reis copied a Portuguese map or maps, corroborating the note he made upon the map in Inscription No. 6. The relatively realistic delineation of the coastline of the northeast elbow of Brazil on the Piri Reis map indicates that the Portuguese source map for this region can be dated after c. 1505 and probably closer to the 1513 date of composition.

The shape of the Atlantic coastline of South America arcs to the east to join a southern landmass. The presence of a land in the south of the globe which connects all major landmasses originated with the ancient Greeks, who believed such a land must exist in order to balance with the *oikoumene*, or inhabited landmass of the northern hemisphere. The Greeks also believed that land surrounded water rather than that water surrounded land, a belief shared by some cosmographers of the early sixteenth century. This theory, in which Africa and Asia were connected to the great Southern Continent — *Terra Australis* — held that the Indian Ocean was a landlocked sea. It originated with Hipparchus in the second century BC and was later promulgated by Ptolemy.[24]

Puerto Rico and the Lesser Antilles

Columbus encountered Puerto Rico and the Lesser Antilles during his second voyage. In 1493 he sailed with a fleet of seventeen ships from Spain to the island of Dominica, the northernmost of the Windward Islands. Sailing north and northwest, the fleet visited most of the Leeward Islands, St. Croix, the Virgin Islands, and Puerto Rico before arriving in Hispaniola.

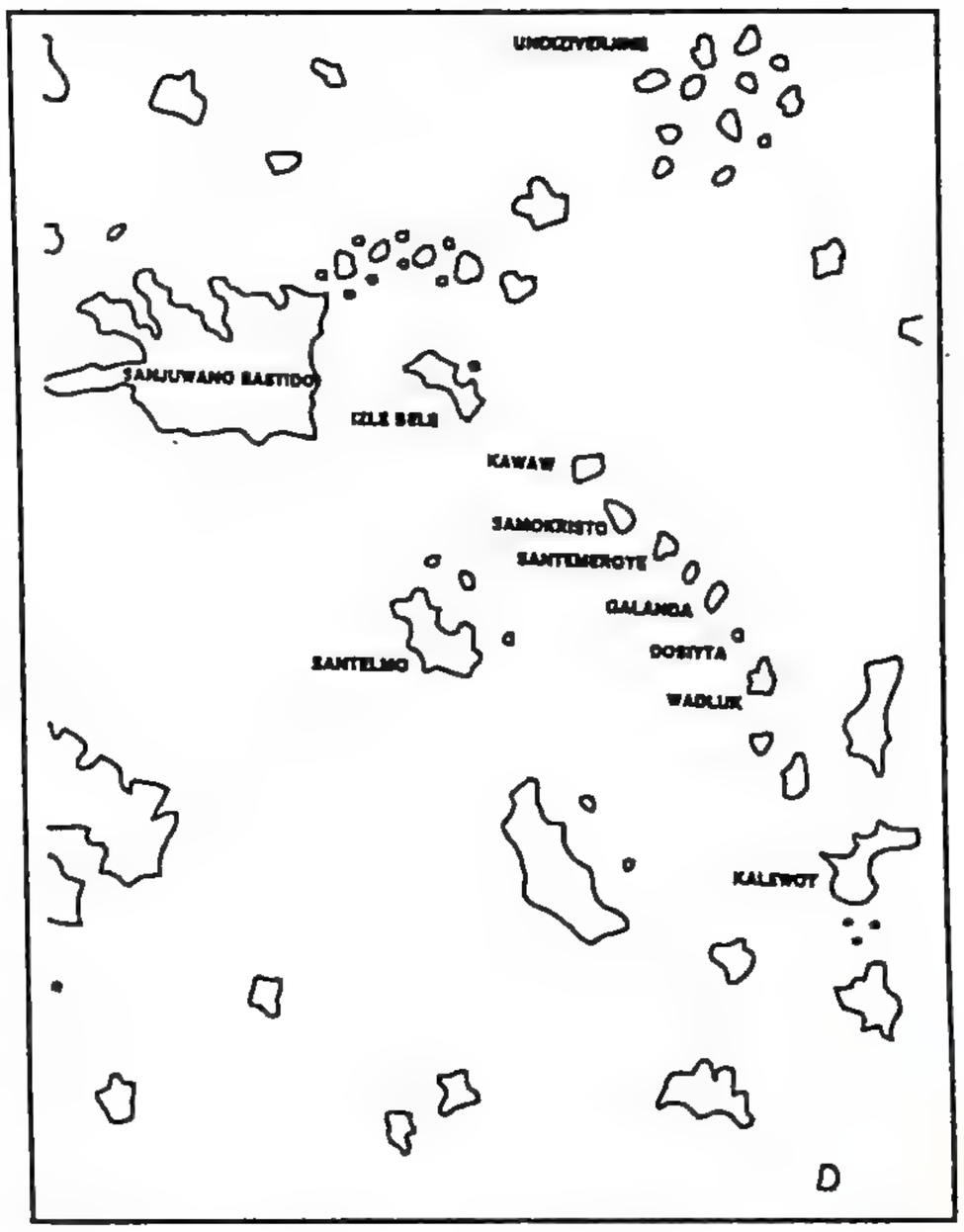

Figure 2: Detail of the Lesser Antilles from the Piri Reis map. The placenames have been transliterated from the original Arabic lettering to Roman lettering.

In many ways the depiction of Puerto Rico and the Lesser Antilles on the Piri Reis map is typical of the earliest surviving maps of this period. Puerto Rico, though shown as a basically correct east-west rectangle, has two (or three) peninsulas at its northwest corner on the Piri Reis map. The name inscribed on Puerto Rico on the Piri Reis map — *Sanjuwano bastido* is *San Juan Bautista*, the name Columbus bestowed upon the island when he discovered it during his second voyage. On sixteenth-century maps it was often named San Juan (or St. John) and the name survives in the name of the capital, San Juan.

Stretching eastward from the northeast corner of Puerto Rico on the Piri Reis map is a string of small islands easily identifiable as the present-day Virgin Islands. Curiously, however, immediately to the northeast of the Virgin Islands is a cluster of twelve islands, which, according to the inscription next to them, are called *Undiziverjine*, which is Italian for "Eleven Virgin[s]." Columbus discovered the Virgin Islands on his second voyage and named them *Las Once M... Vírgenes* (the Eleven-Thousand Virgins) after a popu...

association of Anton de Nolli with the Canaries, suggested in *La Carte de Christophe Colomb* that the Paris Map of c. 1492 (also known as the "Christopher Columbus Chart") was drawn by a Genoese because an inscription on the chart at the Canaries mentions the Genoese.

24. Armando Cortesão, *Cartografia e Cartógrafos Portugueses dos Séculos XV e XVI*, 2 vols. (Lisbon, 1935), 1: 341-42. The Piri Reis map may be the earliest surviving cartographic representation of the austral continent, its next appearance being in the Schöner globe of 1515. See also Justin Winsor, ed., *Narrative and Critical History of America*, 8 vols. (Boston: Houghton, Mifflin and Company, 1889), 1: 7; Raymond H. Ramsay, *No Longer on the Map* (New York: The Viking Press, 1972), 26.

medieval legend.[25] The duplication of the Virgin Islands, once in their correct form and location (but, unnamed), and again immediately to their northeast as a mere cluster, provides a clue to how Piri Reis extracted the information from the various source maps he used, as he mentions in Inscription No. 6.

Stretching to the southeast in an arc towards South America is a string of islands depicting most of the Leeward Islands (the northern half of the Lesser Antilles) to Dominica, the northernmost island of the Windward Islands (the southern half of the Lesser Antilles). Other early maps also show these islands without the Windward Islands south of Dominica.[26] The names of the Lesser Antilles on the Piri Reis map are identifiable, though they are mixed up and apply to different, nearby islands. From north to south they are *Kawaw, Samokristo, Santemeroye, Galanda, Dösiyta, Wadluk, and Kalewot.*[27]

Hispaniola, the Bahamas, and Cuba

While Piri Reis used a variety of contemporary sources for his depictions of South America, the Lesser Antilles, and Puerto Rico, what remains of his depiction of the West Indies — the Bahamas, Cuba, and Hispaniola — is from the source map by Columbus (see figure 3 opposite).

The island of Hispaniola on the Piri Reis map does not at first glance appear to resemble the true shape of Hispaniola, but two inscriptions identify it. One inscription, transliterated from the Arabic script into Roman letters, is *elcezire izle despanya.*[28] This is a combination of the Osmanli Turkish (Ottoman-Turkish) words *Il*, meaning "country," *cezire*, meaning "island," and the Spanish *isla de españia*, meaning "Spanish Isle."

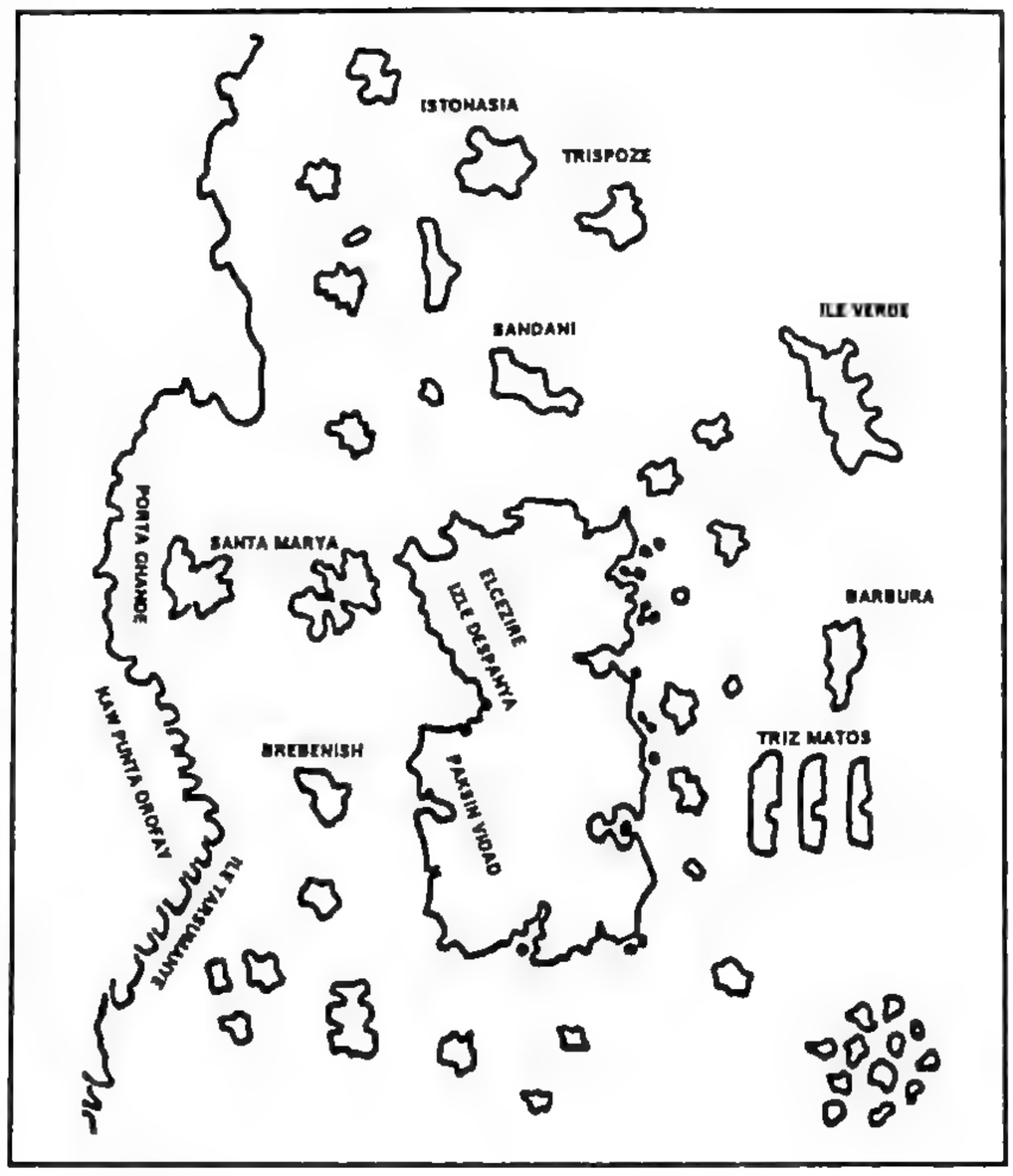

Figure 3: Detail of Cuba, Hispaniola, and the Bahamas from the Piri Reis map, based on the Columbus source map. The placenames have been transliterated from the original Arabic lettering to Roman lettering.

The other name inscribed on the island is *paksin vidad*. This name is undoubtedly *Navidad*, the name of the first settlement founded in the New World by Columbus on Hispaniola and which occurs on only a few other maps.[29] This appears to be a case where the placename has "migrated" from the feature it denoted on the Columbus source map to another nearby feature. Navidad, located on the north coast of Hispaniola, has moved to the south coast on the Piri Reis map to become the placename *paksin vidad.*[30]

25. The maps of the early sixteenth century based upon the Portuguese *Padrão*, e.g., Cantino, Caveri, Ruysch, and Waldseemüller, do not omit the *mil*, or "thousand," as the Piri Reis map does. The "thousand" has apparently been inadvertently omitted by Piri Reis or his calligrapher.

26. The islands to the south between *Kalewot* (Guadeloupe) and the mainland of South America do not conform in size, shape, or position to the remaining Windward Islands and probably do not denote actual islands. Kahle, "A Lost Map of Columbus," 629, presumed these represented the "islands" Columbus had seen between 1 August and 11 August 1498 that turned out to be headlands of the South American continent. Even though Columbus realized by 11 August that they were not islands, Kahle supposed that Columbus continued to show them as islands on his map. *Art Treasures of Turkey* (Washington, D.C.: Smithsonian Institution, 1966), 103, incorrectly states that these islands are named on the Piri Reis map. This error was due to a misreading of the Kahle source above.

27. As before, all names from the map are given as transliterated in Akçura, *Piri Reis Haritasi*, fold-out map, unless otherwise noted. In 1933, Kahle misidentified *Kalewot* (Guadeloupe) as Punta Galeota, a modern name for a feature on Trinidad. Trinidad was discovered by Columbus on his third voyage in 1498. On the basis of this misidentification, Kahle and most subsequent commentators of the Piri Reis map have incorrectly ascribed the date of 1498 to the Columbus souce map used by Piri Reis.

28. Roberto Almagià, "Il mappamondo di Piri Reis e la carta di Colombo del 1498," *Bolletino della R. Società Geografica Italiana* 17, no. 6-7 (June-July 1934): 446, and "Piri Re'is' World Map," 196, reads it as *Gesire . . . destan*. Kahle, *Die verschollene Columbus-Karte*, reads it as *Izle stania*. Josiah Marvel (personal communication) reads it as *elcezire yizladizpanya*.

29. The identification of *paksin vidad* with *Navidad* was first made by Josiah Marvel (personal communication to author).

30. For a similar instance of a Columbian placename "migrating" on a map from one coast of Cuba to another, see Nunn, *Geographical*

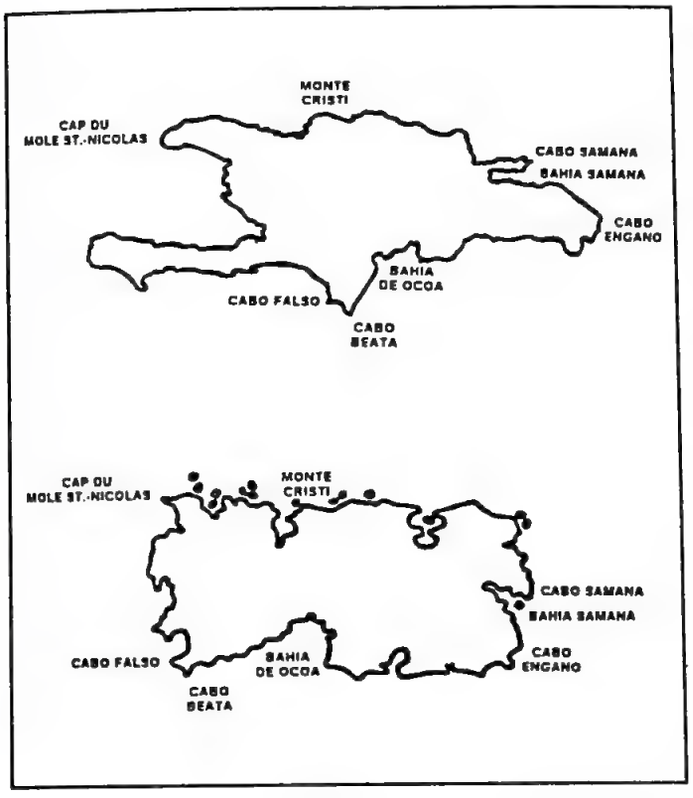

Figure 4: Comparison of Hispaniola from the Piri Reis map, turned 90°, with a modern map of Hispaniola.

Various scholars who have studied this map since its discovery in 1929 have noted the similarity in shape between this island on the Piri Reis map and the island of Cipango.[31] Cipango was the name given by Marco Polo for the islands of Japan and was one of the goals Columbus sought on his first voyage. Columbus and his contemporaries believed that this island of Cipango was rectangular with its main axis oriented north-south. When Columbus discovered the island of Hispaniola during the first voyage he believed it was Cipango. The Piri Reis map shows this island with the traditional north-south orientation of Cipango.

Turning the island of Hispaniola on the Piri Reis map ninety degrees counterclockwise so that its orientation matches the actual island reveals the coastlines visited and mapped by Columbus. This is most apparent in the matching coastlines from Cabo Samana to Cabo Falso. The west coast of Hispaniola and the Gulf of Gonave are missing from the Piri Reis depiction of Hispaniola; this supports Piri Reis's assertion of the Columbian origin of the source map because Columbus never visited these western shores of Hispaniola. The depiction of Hispaniola on the Cantino map of 1502 and the Caveri map of c. 1505, both of which presumably derive from the Portuguese *Padrão*, and the depiction of Hispaniola from Bordone's *Isolario*, bear a remarkable resemblance to the depiction of Hispaniola on the Piri Reis map.[32]

Piri Reis depicted the island of Cuba as mainland on his map, in accordance with Columbus's opinion that Cuba was a great cape of the coast of Asia. The placenames on this mainland and on the islands offshore clearly identify it as Cuba. *Porta Ghande* is *Puerto Grande*, Columbus's name for modern Guantanamo Bay, discovered on his second voyage. This Columbian name does not appear on any other existing map. The name *Kaw Punta Orofay*, that is, *Cabo Punta Ornofay* or "Cape Point Ornofay," is the region on the south coast of Cuba called *Ornofay* by the natives Columbus found there, also on his second voyage.[33]

In describing the north coast of Cuba visited on the first voyage, Columbus wrote in his Letter to the Sovereigns, ". . . I thought it must be the *mainland* — the province of Cathay . . . . At length, after the proceeding of many leagues, and finding that nothing new presented itself, and that the coast was leading me *northwards* . . ." (emphasis added). The *Diario* of the first voyage records that he said of the north coast of Cuba, ". . . this is *tierra firme* [i.e., mainland] . . . and well this is shown by the sea, which comes in a way other than the way it has until now. And yesterday when I was going to the *northwest* I found that it was cold" (emphasis added). Columbus also recorded in the *Diario* that Martín Alonso Pinzón reported to him that ". . . that land [i.e., Cuba] was a very big landmass that went far to the *north* . . ." (emphasis added).[34]

Conceptions of Columbus, 121-122, 127; and Samuel Eliot Morison, *The European Discovery of America. The Southern Voyages AD 1492-1616* (New York: Oxford University Press, 1974), 109n.

31. Afetinan, *Oldest Map of America*, 37; G. E. Crone, *The Discovery of America* (New York: Weybright and Talley, 1969), 209; Kahle, "A Lost Map of Columbus," 630.

32. Armando Cortesão and Avelino Teixeira da Mota, *Portugaliae Monumenta Cartographica*, 6 vols (1960, repr. Lisbon: Imprensa Nacional-Casa da Moeda, 1987), 1: 7, 9; Benedetto Bordone, *Libro di Benedetto Bordone nel Qual si ragiona de tutte l'Isole del mondo* (Venice: Nicolò Zoppino, 1528, repr. Amsterdam: Theatrum Orbis Terrarum Ltd., 1966), 22r; Jane, *Journal of Christopher Columbus*, 87. The *Padrão* was the official map of the Portuguese government upon which the latest geographical information was recorded.

33. Kahle, "A Lost Map of Columbus," 631, and *Die verschollene Columbus-Karte*, 29. Akçura, *Piri Reis Haritasi*, fold-out map, reads it as *Kavpunta Arofi*.

34. For the quotation from the letter, see Jane, *Four Voyages of Columbus* 1: 4; Morison, *Journals and Other Documents*, 182; and Nunn, *Geographical Conceptions of Columbus*, 112. The *diario*, or log, of Columbus's first voyage, is a third-hand abstract containing many copyists' errors, but it also contains many passages quoted verbatim from the original logbook. See Fuson, *Log of Christopher*

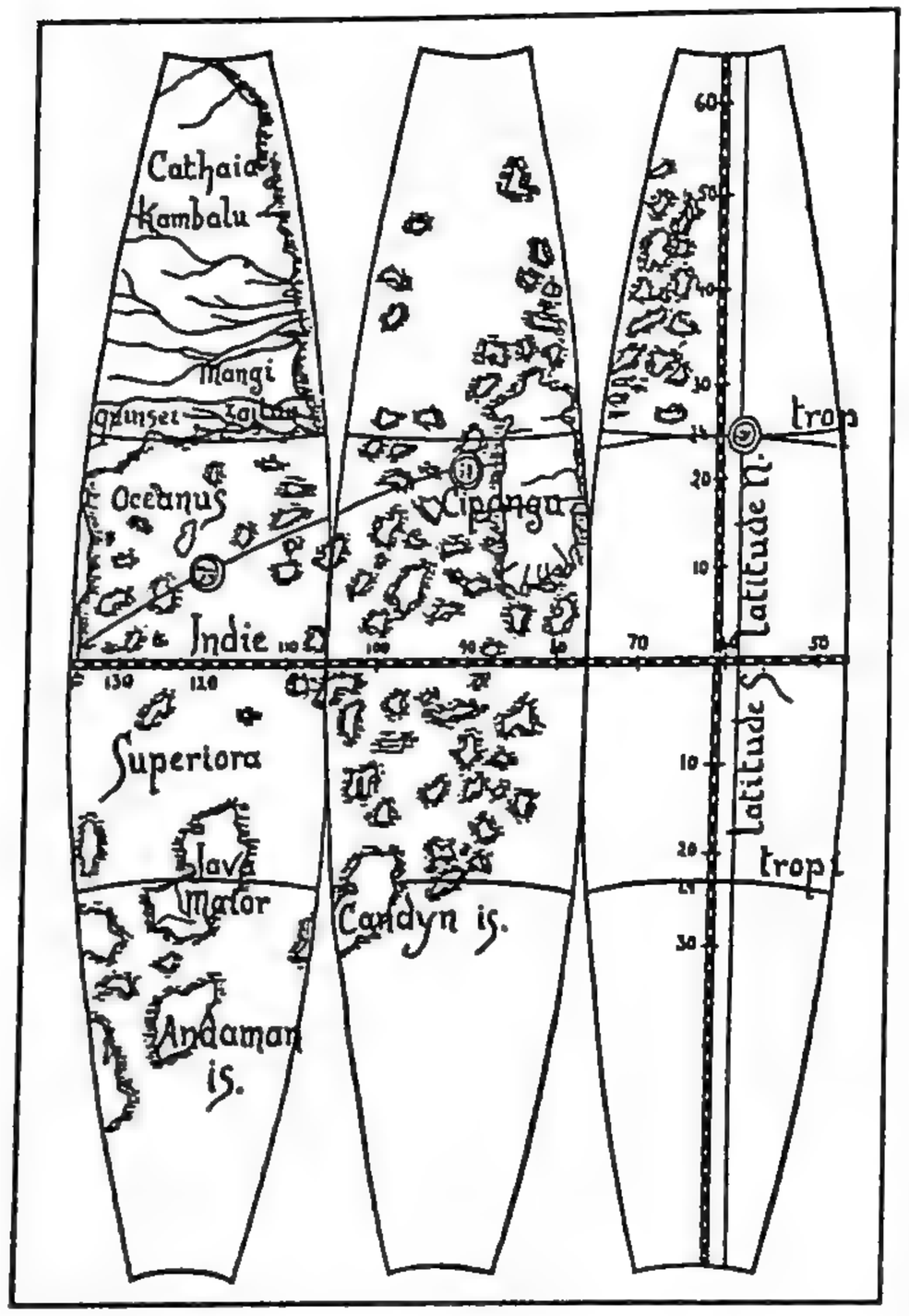

Figure 5: Cipango (Japan) and the east coast of Asia from the Martin Behaim Globe of 1492, a typical late fifteenth-century delineation.

One account records that when Columbus visited the south coast of Cuba, ". . . the shores of Cuba trend so much to the *southward* that he thought himself at times very near the equator" (emphasis added). Of the western terminus of the second voyage, near Bahía Cortés, Columbus said, "From this point onward, the coast extends *southwardly* . . ." and he even compelled his pilots to declare that ". . . from there the country turned *south and southwest* . . ." (emphasis added).[35] Thus, the Piri Reis map follows Columbus's ideas in depicting Cuba as the mainland of Asia with a coastline that trends north and south. Columbus's contemporaries Toscanelli, Martellus, Rosselli, and Behaim held the same conception of the Asian mainland.

On the mainland connecting Cuba with South America is Inscription No. 3, which says: "This territory is known as the province of Antilia. It is in the west." Many in Europe believed (correctly) that the circumference of the earth was larger than Columbus supposed, and the French and Portuguese in particular did not believe Columbus had sailed far enough to the west to have reached the Indies.[36] They thought he had reached Antilia (and so today the Caribbean islands are named the Antilles), the legendary islands shown furthest to the west in the Atlantic Ocean on medieval portolan charts. In fact, the new lands to the west discovered in the late fifteenth and early sixteenth centuries were frequently identified with the legendary islands of the Atlantic — Antilia, Seven Cities, and Brasil.[37]

On returning from his first voyage in 1493, Columbus stopped at Lisbon on his way back to Spain and saw King João II of Portugal, who had twice previously rejected the proposed "Enterprise of the Indies." According to Ruy de Pina, the official chronicler of the reign of King João II, Columbus was returning from "the discovery of the islands of Cipango and Antilia."[38] Many, particularly the Portuguese, believed that the islands Columbus had discovered were the islands of the legendary Antilia and not the coast of Asia. As the regions that he and others explored expanded to include continental mainlands, the opinion continued that these lands were not Asia but the legendary islands of the medieval portolani.[39]

This belief quickly found its way onto contemporary maps. The Cantino map, made in Lisbon in 1502, the Caveri map of c. 1505, the Kunstmann No. 2 map,

Columbus, 51-75, 98; David Henige, *In Search of Columbus. The Sources for the First Voyage* (Tucson, AZ: University of Arizona Press, 1991), 3-4; Dunn and Kelley, *Diario*, 125, 129.

35. Morison, *Admiral of the Ocean Sea*, 464-65; Harrisse, *Discovery of North America*, 85; Nunn, *Geographical Conceptions of Columbus*, 102; Henry Stevens, *Historical and Geographical Notes on the Earliest Discoveries of America, 1453-1530* (1869, repr. New York: Burt Franklin, 1970), 12.

36. Cortesão and Teixeira da Mota, *Portugaliae Monumenta Cartographica* 1: 11; Morison, *Journals and Other Documents*, 177n.

37. On the subject of legendary islands, see Babcock, "The Island of the Seven Cities," *Geographical Review* 7, no. 2 (February 1919): 98-106; Ramsay, *No Longer on the Map;* Henry Stommel, *Lost Islands. The Story of Islands That Have Vanished from Nautical Charts* (Vancouver, BC: University of British Columbia Press, 1984); and Thomas Johnson Westropp, "Brasil and the Legendary Islands of the North Atlantic: Their History and Fable. A Contribution to the *Atlantis* Problem," *Proceedings of the Royal Irish Academy* 30, sec. C, no. 8 (1912): 223-260.

38. Morison, *Admiral of the Ocean Sea*, 347, and *Journals and Other Documents*, 177; Rui de Pina, *Chronica d'El Rey D. Joâo*, in *Collecção de Livros Ineditos de História Portugueza*, ed. J. Coeera da Serra (Lisbon, 1792), 2: 177-78.

39. By 1501, many Portuguese believed that there was one continuous landmass from South America to Newfoundland. See Harrisse, *Discovery of North America*, 108-109; Nunn, *Geographical Conceptions of Columbus*, 131. There was also, however, the opinion of other cartographers who believed the newly discovered lands were Asia or connected to Asia, which influenced their maps. See Errol Wayne Stevens, "The Asian-American Connection: The Rise and Fall of a Cartographic Idea," *Terrae Incognitae* 21 (1989): 27-39.

an anonymous Italian copy of a Portuguese map of c. 1502-06, the Pesaro Map of c. 1508, and several other early maps have inscriptions naming the West Indies the "Antilles" and attributing their discovery to Columbus. In the 1490s Peter Martyr, in describing Columbus's discovery of Cuba and Hispaniola, states: "But the description of the cosmographers well considered, it seems that both these, and the other islands adjoining, are the Islands of Antilia."[40]

On the Egerton MS. 2803 map of c. 1508-13, "Antiglia" occurs as the name of a large inland region in South America, while in North America are seven mitres representing the Seven Cities.[41] This same region in North America on the Juan de la Cosa map contains a barely legible legend which appears to be the words *Terra Setem Civitates* or *Tierra de Siete Ciudades* or *Terra Septem Civitates*, that is, the Seven Cities.[42] The North American landmass on the La Cosa map is made up of at least eight or nine stylized interlocking semicircles. Each of these semicircles has a river flowing from a central lake, each of which has a city in the middle, reflecting the widely held belief that the land Cabot discovered in 1497 was the Seven Cities.[43] Soon after their discovery, various areas of the New World were identified with legendary islands and lands such as the Seven Cities, Brasil, Antilia, Sheba, Ophir, Eden, etc., thought during the Middle Ages to exist in the Atlantic to the west of Europe or to the east in Asia. Thus, the name Antilia appears on the mainland of Central America on the Piri Reis map.

When Columbus arrived off the coast of Honduras on his fourth voyage, he believed that the land was connected to Cuba (Columbus's Mangi or mainland Asia) to the north. This fit his conception of the coast of East Asia. When he sailed south to Panama (Veragua), he learned that the Central American coast was connected to South America. The Piri Reis map displays these two features of Columbian geography — "Cuba-as-mainland" connected to Veragua and Veragua connected to South America.

The "Cuban mainland" of Columbus depicted on the Piri Reis map is markedly similar to the mysterious northwest landmass on the Cantino map and other Lusitano-Germanic maps derived directly or indirectly from the Portuguese *Padrão*, such as the Caveri, Waldseemüller, and Ruysch maps. This continental landmass has been variously identified as Asia, the Yucatan, Cuba, Florida, a purely imaginary landmass, or a composite of several sources.[44] The presence of this wedge-shaped continental landmass with Columbian placenames in the Columbian section of the Piri Reis maps supports the hypothesis that this landmass on the Lusitano-Germanic maps is Columbus's conception of "Cuba-as-mainland."

Conclusions

Although much of what previously appeared to be a confused jumble of delineations in the northwest section of the Piri Reis map has been shown to conform to Columbus's geographical conceptions and Columbian nomenclature, there are aspects of the disarray that are still perplexing. The two most obvious, perhaps, are the shortened width of the Caribbean between the Lesser Antilles and Central America and the displacement of Hispaniola to the north of Puerto Rico. Both of these anomalies could have resulted from the merging of several maps. The compression of the Caribbean may have occurred because of the limitations in the size of the parchment upon which the map is drawn. Furthermore, the West Indies southward from Puerto Rico came from a different map than Hispaniola and Cuba, and this may somehow account for the displacement of the Greater Antilles in relation to the Lesser Antilles.

The orientation of Hispaniola (Columbus's Cipango), though conforming to the then generally held opinion about Cipango, is incorrect, but Columbus is known for his tenacity, hardheadedness, and obstinacy when it came to his ideas. Moreover, adherence to

40. Cortesão and Teixeira da Mota, *Portugaliae Monumenta Cartographica* 1: 12; Morison, *European Discovery of America - Southern Voyages*, 273-74; Edward Luther Stevenson, *Marine World Chart of Nicolo de Canerio Januensis 1502* (New York: The Hispanic Society of America, 1908), 39; Josiah Marvel, "Lucaiarum Tabula Onomastica" (unpublished manuscript, 1988), 12. The quotation appears in Richard Eden, *The Decades of the Newe World or West India*, trans. of *De rebus oceanicis et orbe novo decades, by Pietro Martire d'Anghiera and other works* (London: Guilhelmi Powell, 1555, repr. Readex Microprint Corporation, 1966), 2v, but the spellings have been modernized.

41. William H. Babcock, "The Island of the Seven Cities," 103 and fig. 1, and *Legendary Islands of the Atlantic*, 147 and fig. 8; Davies, "The Egerton MS.2803 Map," maps facing pp. 47, 50; Ramsay, *No Longer on the Map*, 123; Cortesão, *History of Portuguese Cartography* 1: 131.

42. George E. Nunn, *The Mappemonde of Juan De La Cosa. A Critical Investigation of its Date* (Jenkintown, PA: George H. Beans Library, 1934), 37; James A. Williamson, *The Cabot Voyages and Bristol Discovery under Henry VII* (Cambridge: Hakluyt Society, 1962), 82.

43. Wilcomb E. Washburn, "Representation of Unknown Lands in XIV-, XV- and XVI-Century Cartography," *Agrupamento de Estudos de Cartografia Antiga* 35 (1969): 10; Williamson, *Cabot Voyages*, 82, 85, 209, 228.

44. The literature on the identity of the mysterious northwest landmass on the Cantino map is quite large. Two references, which cite all of the additional major sources, are Nunn, *Geographical Conceptions of Columbus*, 91-141, and Clinton R. Edwards, "The Test of Time," in Nunn, 181-188, 191-95.

tradition and authority over experience was still very strong. The cartography and geography of this time is replete with examples of wrong ideas persisting in the face of practical knowledge.[45] In fact, much of Columbus's argument for the "Enterprise of the Indies" was based upon tradition and authority, such as Aristotle, Averroës, Seneca, Strabo, Mandeville, Marinus of Tyre, and the Old Testament. His acceptance of tradition and authority continued for the remainder of his life, as he sought proof that Hispaniola was Cipango (Japan), Cuba was Mangi (China), and that he had discovered a new route to the Indies. To do otherwise was to have failed. For Columbus to have turned Hispaniola 90° to its correct position was to admit it was not Cipango and that his "Enterprise" was a failure.

Nearing the end of his return from Cuba to Hispaniola during the second voyage, Columbus fell ill. After returning to the settlement of Isabela at the end of September of 1494, he lay gravely ill for more than five months.[46] It was probably after this time, between early 1495 and early 1496, that he made the map Piri Reis would later use. It is difficult to accept the fact that Columbus, perhaps the greatest navigator of his time, would contort the orientations of Cuba and Hispaniola as much as ninety degrees out of place, yet this may be what happened. Although there is plenty of evidence of his navigational skills, there is also evidence of his shortcomings as a geographer, particularly during the third voyage to the Gulf of Paria region of Venezuela. At that time he refused to accept the opinion of the experienced sailors with him that the headlands they were viewing were not islands, but the alluvial plains and delta of a great river (the Orinoco). It was also on that voyage that he asserted that the earth was pear-shaped and the region of Venezuela was like a woman's breast that reached closer to Heaven than the rest of the globe.[47] Is it conceivable that Columbus could have been at once one of the best navigators of his day and one of the worst geographers of his time?

45. For example, Scotland, because it is warmer than other regions in Europe of the same latitude (due to the influence of the Gulf Stream), cannot, according to the ancient theory of "climatic zones," be in the same higher and cooler latitudes. Therefore, Scotland is shown on many fifteenth-century Ptolemaic maps "bent over" ninety degrees to bring it into a lower, warmer latitude.

46. Irving, *Life and Voyages of Christopher Columbus* 1: 280; Benjamin Keen, trans., *The Life of the Admiral Christopher Columbus by His Son Ferdinand* (New Brunswick, NJ: Rutgers University Press, 1959), 145-46; Morison, *European Discovery of America - Southern Voyages*, 134.

47. Morison, *Admiral of the Ocean Sea*, 556-59, and *Journals and Other Documents*, 266, n. 11, 283, n. 11, 285-88 and n. 6.

There are diagnostic features of the Piri Reis map, many of them unique to this map, that support the statements by Piri Reis that he copied a map by Columbus. The placenames on the map that exhibit a particular and significant connection to Columbus are *Elcezire izle despanya (Isla de Espania)*, *Paksin vidad (Navidad)*, *Porta Ghande (Puerto Grande)*, *Orofay (Ornofay)*, the island of *Santa Maria* off the coast of Cuba, *Istonasia (Esta en Asia)*, *Bribiniş (Alta Vela)*, and *Barbura (Babueca)*. Moreover, two depictions on the map that reflect Columbus's ideas are Hispaniola as Cipango and Cuba as a wedge-shaped mainland with a coast that trends north from a great cape and another coast that trends west and then curves south from this same cape. This "Cuba-as-mainland" appears in the Cantino map and other maps of the Lusitano-Germanic tradition.

The placenames and depictions in the West Indies on the Piri Reis map indicate a strong connection to Columbus. Yet there is also a certain strangeness about the delineations. It may be hard to see the direct connection to Columbus in this map. Nonetheless, when one adds up all of the Columbian features on the Piri Reis map, there is overwhelming evidence that there is a Columbian map imbedded in the Piri Reis map. It might be tempting to attribute the so-called Columbus source map used by Piri Reis to some other cartographer of the time, perhaps a shipmate of Columbus or someone who took the geography of the newly discovered lands of Columbus and attempted to combine it with the preconceived geography of East Asia. But who might this unknown cartographer be? When we look at the end of the fifteenth century and the beginning of the sixteenth century, there are only two men who fit this description — the Columbus brothers, Christopher and Bartholomew.

The most famous extant map of this period, the Juan de la Cosa map, is a copy made after 1502 of the lost original of 1500. It has been intensely studied since its discovery in 1832 and has frequently been declared to be the earliest cartographic record of the voyages of Columbus. Yet the depiction of Cuba, Hispaniola, and the Bahamas on the Juan de la Cosa map is not earlier than 1500. The Piri Reis map, however, displays the earliest, most primitive and rudimentary cartography of these islands, more primitive than even the celebrated Juan de la Cosa map, a primitiveness which indicates that the earliest of all cartographic records of the discoveries in the New World — a map made by Christopher Columbus or under his supervision about 1495 or 1496 — survives in the Piri Reis map of 1513.

Appendix

The Inscriptions on the Piri Reis Map of 1513[48]

1. There is a kind of red dye called *vakami*[49] that you do not observe at first because it is at a distance . . . .[illegible]. The mountains contain rich ores . . . [illegible]. There some of the sheep have silken wool.[50]

2. This country is inhabited. The entire population goes naked.

3. This region is known as the province of Antilia. It is in the west. They say that there are four kinds of parrots — white, red, green, and black. The people eat the flesh of parrots and their headdress is made entirely of parrots' feathers. There is a stone here. It looks like a black touch-stone. The people use it instead of the ax. That it is very hard . . . .[illegible]. We saw that stone.

4. This map was drawn by the poor man Piri ben Hâdji Muhammed, known as the nephew of Kemal Reis, in the town of Gelibolu[51] — may Allah have mercy on them both — in the month of Muharram of the year 919.[52]

5. These coasts are called the coasts of Antilia. They were discovered in the year 896 of the Arabian calendar. It is reported that a Genoese infidel named *Qulūnbū* [Colonbo or Columbus], discovered these places. It is said a book came into the hands of the said *Qulūnbū* and he found said in this book that at the end of the Western Sea [Atlantic Ocean] there were shores and islands and minerals of every kind, and a mountain of precious stones. This man, having studied this book thoroughly, explained these matters in detail to the eminent men of Genoa and said: "Come, give me two ships, I will go and find these places." They said: "O foolish man, the end and boundary of the world is to be found in the west. It is full of the mist of darkness." The above mentioned *Qulūnbū* seeing that no help was forthcoming from the Genoese, made inquires, and went to the Bey [or King] of Spain, and told his story in detail. He too answered like the Genoese. In the end, *Qulūnbū* talked to the King for a long time and, finally, the King of Spain gave him two ships, saw that they were well equipped, and said: "O, *Qulūnbū*, if it happens as you say, let us make you *kapudan* [Admiral] over that land." Having said this, he sent the said *Qulūnbū* to the Western Sea.

The late Gazi Kemal had a Spanish prisoner. This prisoner said to Kemal Reis: "I have three times traveled with *Qulūnbū* to this land." He said: "First we reached the Strait of Gibraltar, then from there, taking a middle course between west and southwest in the Western Sea, we journeyed straight onwards four-thousand miles until we saw an island opposite us. Gradually the waves of the sea ceased to foam, that is, the sea became calm and smooth, and the North Star — the seamen on their compasses still say Pole Star — little by little became veiled and invisible." He also said that the stars in that region are not arranged as here. They are seen in a different arrangement.

They anchored at the island which they had seen earlier opposite them. The inhabitants of that island came, shot arrows at them and did not allow them to land and ask for information. The men and women shot arrows. The tips of these arrows were made of fishbones, and the whole population went naked and also very . . . [illegible]. Seeing that they could not land on the island they sailed to the other side of the island where they saw a boat. On seeing them the boat fled and the people in the boat dashed onto the land. The Spaniards took the boat. They saw that inside of it there was human flesh. It happened that these people were of the nation which went from island to island hunting men and eating them.

The said *Qulūnbū* saw yet another island to which they went. They saw that on that island there were great serpents. They avoided landing on this island and went to another island and remained at anchor for seventeen days. The people of this island saw that no harm came to them from this ship, so they caught fish and brought them in their small canoes. The Spaniards were pleased and gave them glass beads. It appears that *Qulūnbū* had read it in a book that in that region glass beads were prized. Seeing the beads, the natives brought still more fish. These Spaniards always gave them glass beads.

One day, the Spaniards saw gold around the arm of a woman. They took the gold and gave her beads. They told her: "Bring more gold, we will give you more beads." The natives went and brought them much gold. It appears that in their mountains there were gold mines.

One day, also, they saw pearls in the hands of a person. They saw that when they gave beads many more pearls were brought to them. Pearls were found on the shore of this island, in a spot one or two fathoms deep.

Loading their ship with many logwood trees and taking two natives along, they took them within that year to the King of Spain. The said *Qulūnbū* not knowing the language of these people, traded with them by signs. After this trip the King of Spain sent priests and barley. The Spaniards taught the natives how to sow and reap and converted them to their own religion. The natives had no religion of any sort. They walked naked and lay there like animals.

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48. See figure 6 on page 294. The translations are based upon Kahle, "A Lost Map of Columbus," 621-638; Afetinan, *Piri Reis'in Amerika Haritasi*, 33-39, and *Oldest Map of America*, 28-34; Akçura, *Piri Reis Haritasi*, 20-25; and Marvel, "Lucaiarum Tabula Onomastica," 24-26. The numbering of the inscriptions follows that used in Akçura, *Piri Reis Haritasi* and Afetinan, *Piri Reis'in Amerika Haritasi*, *Oldest Map of America*, and *Life and Works*, except for the addition of a few translated inscriptions omitted in those works. The numbering of the inscriptions used by Kahle in "A Lost Map of Columbus" and *Die verschollene Columbus-karte* is different than that used by Akçura and Afetinan.

49. *Vakami* or *bakkam* is the Arabic word for logwood or dyewood and the reddish dye made from the wood. The English equivalent is "brazil" and "brazilwood."

50. This inscription, though transliterated in Akçura, *Piri Reis Haritasi*, fold-out map, was not translated. This translation is from Afetinan, *Oldest Map of America*, 28.

51. Present-day Gallipoli in European Turkey.

52. Between 9 March and 7 April 1513 AD.

Now these regions have been opened to all and have become well known. The names which mark the places on the said islands and coasts were given by *Qulūnbū* that these places may be known by them. And also *Qulūnbū* was a great astronomer. The coasts and islands on this map are copied from the map of *Qulūnbū*.

6. In this age, no one has seen a map like this. The hand of this poor man [i.e., Piri Reis] has drawn it and completed it from about twenty charts and mappamundi. These are charts drawn in the days of *Iskender dhu-l Karnian* [Alexander, Lord of the Two Horns, i.e., Alexander the Great],[53] which show the inhabited quarter of the world.[54] The Arabs name these charts *Jaferya*.[55] From eight *Jaferyas* of that kind and one Arabic map of *Hint* [Hind, i.e., India], and from four newly drawn Portuguese maps which show the countries of *Sint* [Sind, i.e., China of Ptolemy], *Hint*, and *Çin* [Chin, i.e., China] geometrically drawn, and also from a map drawn by *Qulūnbū* in the western region I have extracted it. By reducing all these maps to one scale this final form was arrived at, so that this map of these lands is regarded by seamen as accurate and as reliable as the accuracy and reliability of the Seven Seas on the aforesaid maps.

7. It is related by the Portuguese infidel that in this place night and day are, at their shortest period, of two hours duration, and at their longest phase, of twenty-two hours. The day is very warm and in the night there is much dew.

8. On the way to the province of *Hint* a Portuguese ship encountered a contrary wind from the shore. The wind drove it from the coast . . . [illegible]. After being driven by a storm in a southern direction they saw a shore facing them. They advanced toward it . . . [illegible]. They saw that there were good anchorages. They dropped anchor and went ashore in boats. They saw people walking about, all of them naked. But they shot arrows with tips made of fish-bone. They stayed there eight days. They traded with these people by signs. That barque saw these lands and wrote about them which . . . [illegible]. The said barque without going to Hinde, returned to Portugal, and gave the news. They sent eight caravels. They described these coasts in detail and from these it is copied.[56]

9. And in this country it seems that there are white-haired wild beasts in this shape, and also six-horned oxen. The Portuguese infidels have written it on their maps.

10. This country is barren. Everything is desolate and in ruins and it is said that large serpents are found here. For this reason the Portuguese infidels did not land on these shores and these shores are also said to be very hot.

11. And these four ships are Portuguese ships. This drawing shows their shape. They traveled from the lands in *Mağrip* [Northwest Africa] to *Habeş* [Abyssinia]. In order to reach *Hinde* [India] they sailed toward the southwest.[57] The distance across this gulf is 4200 miles.[58]

12. . . . on this shore a tower
. . . . is however
. . . . in this climate gold
. . . . taking a rope
. . . . is said they measured.[59]

13. And a Genoese barque coming from Flanders was caught in a storm. Impelled by the storm it came upon these islands, and in this way these islands became known.

14. It is said that in ancient times a priest by the name of *Sanvolrandan* [Saint Brendan] traveled through the Seven Seas. He is said to have landed on this fish, thought it was dry land, and lit a fire on this fish. When the back of the fish began to burn, it plunged into the sea. The people reembarked in their boats and fled to the ship. This event is not reported by the Portuguese infidels. It is taken from the ancient *mappamundi*.

15. To these small islands they have given the name of *Undizi Vergine*, that is to say, the Eleven Virgins.

16. And this island they call the island of Antilia. There are many wild beasts and parrots and much logwood. It is not inhabited.

17. This barque was driven upon these shores by a storm and anchored where it came to lay. Its name was *Nikola di Juwan*. On his map it is written that these rivers which can be seen are mostly gold dust. When the water had run off, they collected much gold dust from the sand.[60] He has written it in his map.

18. This is the barque from Portugal which encountered a storm and came to this land. The details are written in the margin of this map. [See Inscription No. 8].

19. The Portuguese infidels do not go west of here. All

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53. Arab writers often confused Claudius Ptolemy, the geographer of the second century AD, with Ptolemy I, one of Alexander's generals and the first ruler of Egypt, who lived in the fourth century BC, as has Piri Reis, in this case. See Lunde, "Piri Reis and the Columbus Map," 20; O. A. W. Dilke, *Greek and Roman Maps* (Ithaca, NY: Cornell University Press, 1985), 155.

54. The inhabited quarter, called *oikoumene* by the ancient Greeks, was the area of the world depicted on Ptolemy's maps, which was Europe, the Mediterranean Sea, Africa north of the Tropic of Capricorn, Asia to beyond the Malay Peninsula, and the Indian Ocean.

55. Piri Reis or his calligrapher has misspelled the word *jografya*, meaning the maps from the *Geographia* of Ptolemy.

56. This inscription describes events from the voyage of Cabral to Brazil in 1500.

57. Beginning with da Gama, Portuguese ships sailing around Africa to India would sail to the southwest from the Cape Verde Islands in order to avoid the doldrums near the equator.

58. The four ships mentioned, but not shown, must have been on the portion of the map which is lost. This voyage undoubtedly refers to the first voyage of Vasco da Gama from Portugal to Calicut in 1497-99. See Kahle, "Un mapa de América hecho por el turco Piri Reis, en el año 1513, basándose en un mapa de Colón y en mapas portugueses," *Investigación y Progreso* 5, no. 12 (December 1931): 172, though he translates the distance as 1,200 miles.

59. The fact that half of each of these lines is missing clearly shows that the map was torn in two and only this western portion has survived. Perhaps the "tower" referred to is one of the *padrões*, or stone columns, the Portuguese erected along the coast of Africa during their voyages.

60. Shipwrecked sailors who obtained gold from sand was one of the legendary stories about Antilia told by the Portuguese. See Babcock, "Island of the Seven Cities," 100-101, and *Legendary Islands of the Atlantic*, 144-45; Wallis, "Paris Map," 21; Taviani, *Grand Design*, 462-63.

that side belongs entirely to Spain. They have made an agreement that a line drawn two thousand miles to the western side of the Strait of Gibraltar should be taken as a boundary. The Portuguese do not cross to that side but the Indian side and the side to the south belong to the Portuguese.[61]

20. And this caravel having encountered a storm was driven upon this island. The caravel was named *Nikola Juwan* [Nicola di Juan?]. And on this island there are many oxen with one horn. For this reason they call this island *Izle vaka*, which means, Cow Island.

21. The master of this caravel is named *Messire Anton Cineviz* [Sir Anton the Genoese], but he was brought up in Portugal. One day, this caravel encountered a storm and was driven upon this island. He found much ginger here and was the first to write about these islands.

22. This sea is called the Western Sea [Atlantic Ocean], but the *Efren* [Frankish, i.e., European] sailors call it the *Mar de Ispanya* [Mare d'Espana],[62] which means the Spanish Sea. Up to now it was known by these names, but *Qulūnbū*, who opened up this sea and made these islands known, and also the Portuguese infidels who have opened up the region of *Hint* [India], have agreed together to give this sea a new name. They have given it the name of *Ovosano*, which means, Healthy Egg. Before this, it was believed that the sea had no end or limit, that at its other extremity darkness prevailed. Now they have seen that this sea is bounded by a coast, and because it is like a lake, they called it Healthy Egg.[63]

23. In this place there are oxen with one horn, and also wild beasts of this shape.

24. These wild beasts attain a length of seven spans. Between their eyes there is a distance of only one span. Yet, it is said, they are harmless souls.

25. This territory is inhabited and there are many people.

26. *Ile de Sara.* These islands are not inhabited, but, spices are plentiful.

27. *Triz matos*, that is to say, the three madmen.

28. These wild beasts are . . . . [illegible].

29. In the mountains of this region there are beasts in this shape, and on the shores are many men and no end of gold ore.[64]

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61. The Line of Demarcation determined by Pope Alexander VI, according to the Treaty of Tordesillas (1494) between Spain and Portugal, was sometimes shown on maps of the sixteenth century, e.g., the Juan de la Cosa map of 1500, the Portuguese-made Cantino map of 1502 and the Spanish-made Salviati map of c. 1526.

62. On the Leardo map of the world of c. 1453, the name inscribed on the Atlantic Ocean is *Mare de spagnia*. See John Kirkland Wright, *The Leardo Map of the World, 1452 or 1453* (New York: American Geographical Society, 1928), 56. This feature on the Piri Reis map, plus others such as St. Brendan and the whale, confirm the statement in Inscription No. 6 that mappamundi were used in making the map.

63. This seems to be Piri Reis' quaint, but misconceived, idea of the origin of the name "Ocean" (Ovosano) from Italian or Spanish words — *uovo* or *huevo* (egg) and *sano* (healthy).

64. The author wishes to express his gratitude to Dr. Thomas Goodrich for providing this translation.

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Book Reviews

ROBERT GARDINER AND BRIAN LAVERY, EDS., *Conway's History of the Ship. The Line of Battle: The Sailing Warship 1650-1840* (London: Conway Maritime Press, 1992). Cloth, 208 pages, photographs, tables, drawings, bibliography, glossary, index. £28.00. ISBN 0 85177 561 6.

This is the second volume in Conway's much-anticipated twelve-volume reference series, and it continues to set very high standards indeed. Because it deals with such a broad subject, this ambitious series must have been an organizational headache at best, and if this book is indicative of the quality of forthcoming volumes, the editors are to be congratulated in advance. The book is authoritative and thorough, yet concise, easy to read, and never pedantic.

The book's stated objective is to chronicle the development of the western world's warships beginning around 1650, with the general acceptance of lower deck gun ports that spawned line-of-battle tactics, to the eclipse of sailing warships perpetrated by the advent of steel and steam around 1840. The volume meets this goal in an exemplary manner, as it deals with all of the complex factors that influenced ship design during this period: politics and economics, war and retrenchment, complacency and stagnation, lack of inventiveness or the influence of foreign navies, technological advances, and the progress of ordnance design. It also accounts for geographical restrictions and ambitions, such as the shallowness of Dutch coastal water and the influence of global warfare due to colonialism. In meeting this goal, the authors have inadvertantly written a short history of the western world during the period, since international power and naval strength were inseparable.

The period discussed in this volume begins with the might of Spain greatly diminished, though she was always a presence and reemerged during the Napoleonic wars, and with the Dutch and English vying for naval superiority in Europe. It then moves to an era when Britain and France were rivals for sea superiority, with less powerful nations such as Portugal, the Baltic States (including Russia), and some Mediterranean states always in the background and, indeed, sometimes in the foreground. Finally, for the last seven decades of the period, the United States made its presence felt with a fledgling navy whose ships reflected the needs of a government whose foreign policy differed dramatically from that of the European nations. While naval policy and ship development of all seafaring nations are well described, a good deal of the information contained in this book pertains to the Royal Navy. This is the result of the wealth of source material on British ships and of an abundance of recent research and publication for the period in question, and the fact that Britain was usually the dominant sea power of the time.

The book is comprised of fourteen chapters, each written by an authority in a given subject. The chapters are really a series of well-rounded essays that may be read independently but are, naturally, interrelated. Indeed, there is a good deal of cross-referencing among chapters.

The first seven chapters deal with generic vessel types. They are "The Ship of the Line" by Lavery, "The Frigate" by Gardiner, "Sloop of War, Corvette and Brig" also by Gardiner, "The Fore-and-Aft Rigged Warship" by Karl Heinz Marquardt, "Fireships and Bomb Vessels" by Chris Ware, "The Oared Warship" by Jan Glete, and finally "Support Craft" also by Lavery. In all chapters the authors give the genesis of each ship type, describe its evolution, and give the reasons for, and results of, its development. A well-conceived table is provided at the end of each of these essays that lists representative vessels that are pertinent to understanding the development of the type in question. The tables are arranged chronologically and give names, dates, number of guns, etc. For comparison's sake, the tables give dimensions in native measure and their metric equivalents.

The last chapters are more diverse as they are devoted to general topics relating to shipbuilding and handling. Chapter eight on "Design and Construction" by Gardiner gives an overview of ship building techniques of the period and includes materials employed and technical advancements made. The essay also examines the design process and gives all of the factors that contributed to a ship's final form.

"Rigs and Rigging" by Marquardt examines the various square rigs, fore-and-aft rigs, and standing and running rigging as the title suggests, and discusses spars

and sails as well. In short, all of the top hamper. The application and progressive development of "Ships' Fittings" are discussed in another essay by Lavery. Fittings that are examined include steering gear, ground tackle, pumps, underwater protection, and boats. This study also points out some of the subtle differences among various navies and discusses officer and crew accommodations.

Chapter eleven on "Guns and Gunnery" by Gardiner tackles the important subject of naval ordnance. Sailing warships and naval guns developed alongside one another, and the existence of one supported the existence of the other. The period examined in this volume began with a confusing array of guns of many calibers that were a holdover from the Tudor era, progressed through an age that attempted to standardize armament, and ended with a period of innovation that produced mortars, carronades, howitzers, and eventually shell guns. This chapter, like the book's first seven, ends with a table that summarizes the progress of gun design.

"Ship Decoration" is a subject that has not received much attention in the past, so the inclusion of this essay by John Franklin is most welcome. The author describes the highly decorated ships, the floating sculptures, of the 1650s and explains how and why decoration fell from favor by the end of the period, when warships were very austere.

Many of the reasons ships were designed as they were appear in "Seamanship" by John Harland. This chapter is a synopsis of the author's *Seamanship in the Age of Sail* (London, 1984), and it clearly demonstrates sailing principles, design considerations, and ship handling, including the techniques employed in battle. The explanatory drawings given here are particularly useful in understanding what may appear to be a complex subject.

Chapter fourteen by Nicholas Tracy deals with "Naval Tactics" and discusses the strategies of sea warfare. Beginning with the hit-and-run tactics employed prior to 1650, typified by those used against the Spanish Armada in 1588, the author describes how "line-of-battle" tactics evolved, while considering ship and ordnance development, and examines the problems of coordination, control, and signalling. Here again, very helpful diagrams enhance this study.

Finally, the book's bibliography and glossary should prove to be of great value to the reader. The bibliography lists what are likely the best in-depth sources, contemporary and modern, for further research into each topic covered by the book and gives a short evaluation for each listing. While the glossary does not profess to be a dictionary *per se* (the editors assume that the reader will have at least a modest knowledge of maritime terminology), its concise definitions of vessel types make it worthwhile, as do its definitions of non-English expressions.

In keeping with the publisher's tradition, the book is well illustrated with photographs of models and reproductions of contemporary draughts and paintings. Some of the chapters contain drawings produced by their authors, notably Franklin, Lavery, and Marquardt, and all are of a very high standard. Even the dust jacket is worthy of note; it boasts a beautiful painting by marine artist Mark Myers.

The editors outline their objectives in the preface (p. 6) and here it is worth quoting the series editor: "It has been conceived as a basic reference work, the essential first step for anyone seeking information on any aspect of the subject. . . . The intention is not to inform genuine experts in their particular area of expertise, but to provide them with the best available single-volume summaries of less familiar fields." With these objectives in mind, the book is an unqualified success, but it is also recommended to the junior student, who can gain a very broad, albeit general, knowledge of the subject from it. In addition, this volume will dispel many of the erroneous notions that seem to be rife in maritime studies before they materialize.

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GEORGE E. BUKER, *Jacksonville: Riverport-Seaport*. Studies in Maritime History Series, William N. Still, Jr., ed. (Columbia, SC: University of South Carolina Press, 1992).

George Buker's *Jacksonville: Riverport-Seaport* is, as the dust jacket claims, "a sweeping narrative of the port of Jacksonville's maritime activities from Jean Ribault's landing in 1562 to military shipping for Operation Desert Shield in 1990." But the work offers much more. In fifteen chronological chapters the author provides a blend of local, regional, and national maritime history while chronicling Jacksonville's rise from barren isolated outpost to major automobile import center. More importantly, it details the social, political, and economic changes that accompanied the city's rise to importance.

Jacksonville, situated on the St. Johns River, has been, as Buker maintains, a port searching for its identity. During the 250-year period from its establishment by French Huguenots in 1562 until its acquisition by the United States in 1819, the port, as well as Florida itself, was but a pawn in European affairs. While Florida was held intermittently by the French, Spanish, and English, it never developed beyond a military barrier between Spanish possessions to the south and those of her European rivals to the north. Although the St. Johns' shallow, treacherous mouth discouraged attempts to develop the river valley's commercial potential, it did not hinder

military activities between the English settlements to the north and the Spanish outpost of St. Augustine. In fact, the St. Johns River became, as the author vividly portrays, the military highway for both English and Spanish forces and remained so until 1763 when Florida was transferred to Great Britain.

Florida's economic and commercial potential overshadowed its military importance for British governors trying to build a profitable colony. Only after experimenting with several products, including indigo, did the region become an important source of naval stores for the mother country. In 1782, St. Johns Town (precursor to Jacksonville) exported some fifty thousand barrels of turpentine, yet few Englishmen realized Florida's economic potential — thus the region was returned to Spain in 1783 following the American Revolution. During the last period of foreign rule, 1783-1819, warfare and violence were prevalent. Spanish control over the region was tenuous, as the peninsula became a haven for renegade Indians and runaway slaves. Furthermore, American filibustering attempts in both East and West Florida, cattle rustling by runaway slaves and Indians, and the Spanish use of black troops to garrison the peninsula only added to the confusion. While Andrew Jackson's Florida raid in 1818 demonstrated American resolve to suppress the lawlessness of the region, it also pressured the Spanish government to cede the peninsula to the United States, which formally took possession of it in July 1821.

From the period of annexation until the end of the nineteenth century, there were several attempts to exploit the St. Johns River, but to no avail. The sand bar located at the river's mouth hindered the economic growth not only of the city but also of the entire region. Jacksonville, however, did gain access to the outside world because of the side-wheel steamboat. With its shallow draft, this vessel transformed the city from riverport to seaport. The steamboat era represented the beginning of Jacksonville's development, as it saw blockade running and privateering during the Civil War, filibustering during the Cuban Revolution, and the development of coastal defenses during the Spanish-American War.

At the beginning of the twentieth century, Buker asserts, railroads replaced steamboats, the channel of the St. Johns River was opened, and the city looked outward to its future. Yet not until 1931 was Jacksonville's future determined. In that year Congress appropriated money for creating a carrier docking basin at the Mayport Naval Station. That decision ensured that the St. Johns River would constantly be dredged to accommodate deep-draught aircraft carriers. Thereafter, Jacksonville could accommodate even the largest supercargoes and develop its multifaceted seaport resources. Since World War II, the port has become a leader in the container revolution and has witnessed the beginnings and maturation of the automobile trade. These recent developments, administered by the Jacksonville Port Authority, have transformed the harbor into a modern commercial facility with thirty-four terminals along a twenty-five-mile stretch from downtown Jacksonville to the sea. More recently the port has served forces from the Mayport Naval Station involved in Operation Desert Shield. Ironically, after four centuries of development, Buker maintains that Jacksonville's future is once again tied to world economic rivalry and health.

By breathing life into the story of this important port, Buker has established himself as the authority on the region's maritime development. *Jacksonville*, his third book on Florida's maritime past, is an admirable attempt at defining the city's importance in relation to the country's maritime heritage. Yet while describing the evolution of this secondary port, the book leaves one searching for more about its development. Nonetheless, this is another fine addition to the University of South Carolina Press' Studies in Maritime History Series, and a worthwhile study of an important port overlooked by historians and enthusiasts alike.

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ROBERT L. GANDT, *China Clipper, The Age of the Great Flying Boats* (Annapolis, MD: Naval Institute Press, 1991). 320 pages, illustrations, bibliography. $29.95.

Inasmuch as flying boats have an undeniable kinship with nonflying boats, the maritime history establishment should have a natural curiosity about these airplanes, their similarities to and differences from their marine counterparts, and their role in developing the transoceanic flying that has come to complement, compete with, and in some cases supplant seagoing shipping.

China Clipper is a highly readable book which describes, all too briefly, the broad milieu in time and place identified in its subtitle, which reflects the essence of the book more accurately than does the title. The author, a naval aviator, international airline captain, and aviation journalist, does a remarkably comprehensive job of explaining in only 170 pages of text how the United States, Britain, France, and Germany each developed the flying boat. Driven by national pride, their efforts were sometimes uneconomical and impractical, but they served to test the concepts that would ultimately evolve as the flying boat became an important step in creating the modern long-range transoceanic airplane.

Combining business history, technological exposition, and personality profiles, Gandt describes how the fledgling

civil aviation industry in various nations, but particularly in the United States, conceived and ultimately produced flying boats for commercial purposes. This goal was accomplished with the cooperation of the military and with the support of the national government through subsidies, largely in the form of mail contracts.

Along with the conventional evolution of airframes and engines that one associates with aviation history, the reader also learns of some unusual and little-known experiments to overcome problems unique to getting flying boats airborne. To minimize the resistance of the water surface to free the departing plane, and to accommodate the weight of the fuel needed for long flights, for example, planners developed successful but short-lived responses such as catapulting commercial flying boats from ships in the manner of cruiser scout planes, piggy-backing a smaller plane from a larger plane designed only as a lift-off facilitator, and midair refueling.

Readers interested in maritime history will appreciate the efforts of the flying boat operators to build on a maritime tradition. Pilots were captains (in one case the designation master was used), cockpits sometimes became bridges, work shifts were called watches, and elements and terminology of marine navigation were incorporated into aerial navigation — in the hands of ex-ship navigators such as the famous Fred Noonan. Gandt also describes briefly two ventures by American steamship operators into overseas aviation: that of Pan American-Grace in South America and that of American Export Airlines to Europe.

Although Pan American Airlines and its clipper fleet are a central thread running through the book, the company is not the author's primary focus. Published in 1991, the year the firm went bankrupt, the book acknowledges the special relationship and trust that Pan Am once enjoyed with the government but makes no mention of the company's declining fortunes. Gandt laments the passing of the flying boats, although he acknowledges that the technological changes in aviation had made them obsolete.

Judging from the endnotes and bibliography, an extensive literature already exists for flying boats. Consequently, this book appears to have been conceived as a survey for the layman, a task at which it succeeds admirably. Gandt writes with a relaxed and casual style, and, except for technical explanations, seldom uses paragraphs of more than two or three sentences, making for easy readability. Technical explanations may momentarily slow the reader, but a reference to the beautiful thirty-two-page section of illustrations makes the author's point clear. Occasionally he is too brief, as in a fleeting reference to a Japanese airline that used the German Dornier flying boats — a reference that one cannot find in the rather skimpy index — perhaps as early as the 1920s, a fact that might be of some interest in a book that alludes to the Japanese presence in the Pacific as one of the problems in making the *China Clipper* a reality.

Some fascinating little-known wartime adventures of the clippers emerge from the pages of the book. One is the story of the *Pacific Clipper*, which at the start of World War II flew home from New Zealand by going west, becoming the first flying boat ever to go around the world, a story of guesswork and improvisation that ranks with the accounts of any of the great ocean voyages of that era. A more routine trip in 1943 ended in tragedy when the *Philippine Clipper*, which had been used in a shuttle to Hawaii for a year, crashed into the rain-drenched coast range while trying to find San Francisco Bay, ninety miles to the south, while the pilot believed he was holding over the Farallon Islands, outside the Golden Gate.

The plane which bore the specific name *China Clipper* — as opposed with the generic use of that name for the transpacific service — crashed into the Caribbean in 1945. "With the death of the *China Clipper*," concludes the author, "the age of the great boats had come to an end." Fortunately for us, Gandt has done a splendid job of telling the story of that age and of capturing the nostalgia that exists so abundantly in a field of history as short as that of aviation.

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MICHAEL BLOW, *A Ship to Remember: The* Maine *and the Spanish-American War* (New York: William Morrow and Company, Inc., 1992).

On the night of 15 February 1898, the battleship *Maine*, while on what today would be called a naval "presence" mission to Cuba, was destroyed by an explosion at her anchorage in Havana harbor. More than 260 officers and men, about two-thirds of the *Maine*'s complement, perished with their ship. The disaster helped to bring on the Spanish-American War, from which the United States emerged with imperial possessions in the Philippines, Guam, and Puerto Rico, a *de facto* protectorate over Cuba, and at least associate membership in the club of great world powers.

For all its historic importance, the cause of the explosion that demolished the *Maine* remains an unsolved mystery. There has never been any doubt that detonation of part of the forward ammunition magazines was the immediate agent of destruction, but what set off the magazines is the tantalizing question. Two U.S. Navy courts of inquiry, one in 1898 immediately after the event and another in 1911-1912 when the *Maine* was raised and towed out of Havana harbor to her final resting place at

sea, both concluded that an external explosion, probably of a mine, triggered the fatal blast. These verdicts, based on thorough examination by qualified naval officers of the physical evidence of the wreck and the testimony of *Maine* survivors, were received with respect within the naval and engineering communities of the time. However, there was dissent from their conclusions. Many experts, then and later, raised technical objections to the mine theory and argued instead that the magazine explosion was most probably an accident resulting from some cause within the ship.

This thesis received strong support in 1976 from Admiral Hyman G. Rickover. On the basis of a detailed review by present-day navy experts on explosives and marine engineering of the evidence amassed by the two courts of inquiry, Rickover concluded that a coal bunker fire on board the *Maine*, resulting from spontaneous combustion, most likely detonated the magazine. Yet this explanation, which was advanced at the time, cannot be proven conclusively. There were, and are, objections to it. For example, although coal bunker fires of the type hypothesized in Admiral Rickover's study occurred on several other U.S. warships during the Spanish-American War period, none caused a magazine explosion or destroyed a vessel. The crews detected the fires by one means or another and put them out before they could do major damage. According to survivors' testimony, the officers and crew of the *Maine*, aware of the fire danger, kept close watch on the coal bunkers and noticed no signs of excessive heat, smoke, or flames before the explosion.

There are other explanations for the tragedy, such as an explosive device planted on board the ship. In the age of the Beirut barracks bombing, terrorism seems perhaps easier to believe as a possible cause of the death of the *Maine* than it did a few decades ago. There were Cubans and Spaniards in 1898 who had both motive and means to destroy the American battleship, but no solid evidence exists on which to indict any particular culprits. It must be recalled that most of the men who were in the fore part of the *Maine* in the last hours and minutes before the explosion perished with their ship; their evidence, which might clear up the mystery, can never be heard.

In *A Ship to Remember*, Michael Blow, grandson of a *Maine* survivor, describes the battleship's last voyage, the explosion, the courts of inquiry, and the various explanations for the disaster, and summarizes the course of the brief American war with Spain. Blow, an editor of *American Heritage*, writes well and has a good eye for the colorful quotation and incident. Unfortunately, his book, based on standard secondary sources and the oft-used memoirs of Theodore Roosevelt and a few other figures, adds little new to our knowledge of either the *Maine* or the war with Spain. His treatment of the explosion, for example, simply summarizes earlier work, including Admiral Rickover's study, while hinting without firm evidence that terrorism cannot be ruled out as the cause. Blow's rehash of the Spanish-American War is superficial at best, with excessive emphasis on the Rough Riders and the antics of Hearst and other so-called "yellow journalists," whose influence in bringing on the war most historians now discount. The only original insight in Blow's volume is the suggestion that Admiral William T. Sampson, the fleet commander at Santiago, might have been suffering from the early stages of Alzheimer's disease.

In summary, this is another in a seemingly endless line of popular histories of the *Maine* disaster and the war with Spain. In the popular vein it is inferior in both research and interpretation to G. J. A. O'Toole's *The Spanish War*, published in 1984, and it is not in the same league as David Trask's authoritative scholarly study, *The War with Spain in 1898*. For investigation of the issues concerning the *Maine*'s destruction, Admiral Rickover's book and its appended technical report remain the indispensible and authoritative starting points.

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VIMALA BEGLEY AND RICHARD DE PUMA, EDS., *Rome and India: The Ancient Sea Trade* (Madison, WI: University of Wisconsin Press, 1991). xix + 226 pages, 14 maps, 191 illustrations.

This valuable work is not an introduction or general treatment of the subject (for that the reader will need the works of Warmington and Raschke mentioned in the introduction), but a series of studies which treat most aspects. Some are of general interest, others are highly specialized, but all are usefully summarized and tied together in the introduction by Begley.

Readers of this journal will probably profit most from the first two studies. Lionel Casson's brief discussion of ancient naval technology analyzes the problems of using the monsoons to sail between Roman Egypt and India. He explains their directions and strength, and the consequent need (and ability) of the Romans to build large powerful ships for the journey. Expense and size were justified by the value of the cargo. For local transport along the Indian coast, though, the smaller Indian vessels were adequate.

Stephen Sidebotham's study of ports of the Red Sea presents several sites involved in the Indian trade, from Arsinoe near Suez to Berenice at the latitude of Aswan. The existence of these ports along a shore so desolate that even water had to be brought in was justified by the profits from the Indian trade. They were the centers of

export of gold and silver, barley and wheat, wine, textiles (dyed in the ports), and glass (sometimes manufactured there). Imports were luxury goods, exotic animals, slaves, cotton, incense, and myrrh, the last two essential for medicine and religion. Arsinoe, near the Nile - Red Sea canal, may have been used for bulky goods, the others for luxuries. The ports themselves were pretty squalid places, densely occupied only when ships arrived and left. Detachments of troops protected them, the Red Sea, and the tracks to the Nile, for which travellers had to buy passes. They flourished in the first and second centuries A.D., with some reviving in the fifth through seventh centuries. Only one functioned in the Islamic period. This study, in particular, makes the trade come alive.

Five of the thirteen essays deal with pottery, the most common and informative artifact of this trade. Although most of these are definitely for the specialist, they offer conclusions of general interest about the chronology and nature of the trade.

Imitation of Roman pottery in India, discussed in an essay by Begley, provides the earliest evidence for trade. Molded ware in the northwest finds its closest parallels in Hellenistic pottery and metalwork, while the rouletted pottery of the southeast Coromandel cost and adjacent interior regions may go back to the second century B.C. The two groups are unrelated, representing areas unconnected with each other, though both traded with Rome. This pattern is shown to antedate our major text, the *Periplus of the Erythrean Sea.* On the other hand, the red polished ware from Gujerat, discussed by Orton, is shown to be Indian, without Roman influence.

Essays by Will and Slane analyze Roman pottery found in India, especially at Arikamedu on the Coromandel coast. Amphoras contained Greek and later Italian wine, garum (a fish sauce for flavoring) and oil. The wine was an export commodity; the fish sauce and oil were for consumption by the local Romans, who also used the fine tablewares, which were not valuable enough for trade. This analysis gives an implied warning about conclusions: it would have been easy to imagine that all the imports were for the Indian trade and to arrive at some totally false conclusions. The pots show that the trade began in the second century B.C. and dropped off drastically after the first century A.D. Analysis of the polished red ware, *terra sigillata,* in an essay by Comfort, shows that is was assembled in Egypt from various parts of the Mediterranean, reflecting currents of trade within the Empire.

The volume also contains a tantalizing report by Carswell on the port of Mantai in Sri Lanka (which may provide the key to understanding the trade between Rome, India, and China but is now in a danger zone) and some provocative concluding remarks by David Whitehouse.

All in all, this is an extremely valuable volume. It does not introduce the subject or give all the answers, but does provide material for understanding the problems; it will surely be the foundation for all future research. One essential element, however, is missing: the coins. Roman coins, found in large numbers in India, provide major evidence for the trade. They are not included in this volume but have been the subject of a recent and equally valuable study by Paula Turner, *Roman Coins from India* (London, 1989). It may be useful to summarize her conclusions here in order to complete the picture.

The volume, which includes a full catalogue of all the hoards and individual finds, with numerous maps and tables, shows that the coins are associated with the sea trade which, by their evidence, flourished from the first through the third centuries A.D. in two stages. Silver dominated in the early first century, but after the Romans debased their silver, gold replaced it, with large numbers of coins found from the second and early third centuries. The coins were used as bullion, not for circulation (though they did give rise to important local imitations). The coins changed again in the fourth century (not studied here), with no more of precious metal but substantial finds of copper coins. Coin evidence therefore confirms that the trade reached its height under the early Empire.

The coins come from two main areas, around Coimbartore, inland from the (southwest) Malabar coast, and in the valley of the Krishna east of Hyderabad. None were found at Arikamedu or along the Coromandel coast, suggesting that the heavy Roman ships were not rounding Cape Comorin, beyond which they had to pass through the treacherous shallows between India and Ceylon before the second century. The concentration at Coimbatore may be explained by the local beryl mines, the trade in pepper on the coast, and the location by the pass which leads to southeast India and the Coromandel coast.

Otherwise, virtually no coins are found along the west coast of India, suggesting that ships made few stops here once the monsoons were mastered. Absence of Roman coins from a major port like Borach (in Gujerat) reflects a different factor, for here they were melted down to provide silver for the local coinage.

Plainly, the coins offer important evidence which suggests a somewhat different pattern of trade, both in time and space, from the pottery. They raise further questions and suggest new lines of research. When the two are integrated, and further studies like these are made, it should be possible to reconstruct the entire picture. In the meantime, these volumes are to be highly commended to anyone interested in the questions they discuss or raise.

CLIVE FOSS

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JOHN B. DWYER, *Seaborne Deception, The History of the U.S. Navy Beach Jumpers* (New York: Praeger Publishers, 1992). 9½" x 6", cloth, xi + 151 pages, 24 black-and-white illustrations, 6 maps, glossary, bibliography, index.

Tactics can be defined as the art and science of arranging and maneuvering armed forces in combat in conjunction with firepower to achieve the complete subjugation of an enemy, not only on the ground but also on the sea and in the air. Two fundamental principles of war, fire and movement, are employed to attack a hostile force under conditions most favorable to oneself and to overwhelm the adversary by means available coupled with mobility. Obviously, control is mandatory, and uninterrupted and secure communication channels are paramount. Any hostile invasion of communication facilities either by physical or mechanical means, not to mention deliberate deception, can seriously hamper if not totally destroy "the best laid plans of mice and men."

The U.S. Navy's tactical cover and deception units, the Beach Jumpers, were purposely conceived to exploit the vulnerability of enemy communications and to support friendly amphibious assault landings, initially in the Mediterranean theater of operations. Their incipient labor pains and difficult birth were complicated by several factors. For one thing, dual ideological foundations were present: one was conceptual-control, organization, and function under Commander, Amphibious Force, Atlantic Fleet; the other was mechanical-technical imposed by National Defense and Research Development agencies plus the Naval Research Laboratory. In addition, from start to finish there were frequently "too many cooks in the soup" of varying levels of interest and influence, to the degree that it was difficult to pursue an objective on true course and steady speed when confronted by many competing and sometimes overlapping, on-the-spot overlords and inter- and intra-service rivalries, domestic as well as foreign.

From the very outset the Beach Jumper planners faced serious problems. Foremost was the literal "sale" of a novel concept to the highest level of the naval hierarchy, as well as to the Joint Chiefs of Staff, with positive proof that the product was not only feasible but would also contribute materially to the war effort. Furthermore, the planners had to formulate criteria and curricula, doctrine, and a training syllabus practically from scratch and to procure and install highly sophisticated electronic devices requiring equally specialized delivery craft. Fortuitously, they found their champion in the dynamic personage of Lieutenant Douglas E. Fairbanks, Jr., USNR, who, with unbounded self-assurance, buttressed by extensive prior indoctrination, training, and experience with British Admiral Mountbatten's Combined Operations Command, sought the assistance of Admiral H. Kent Hewitt, USN, Commander, Amphibious Force, Atlantic Fleet, at Norfolk in October 1942. Eventually, with Hewitt's sponsorship, Fairbanks won grudging approval of the entire scheme from Admiral Ernest J. King, USN, Commander-in-Chief, U.S. Fleet and Chief of Naval Operations. This was no mean feat on Fairbanks' part, as Admiral King was very distrustful of anything accompanied by superficial glamour and was averse to any concepts based on borrowed British projects. Although the timing of Fairbanks' Beach Jumper proposal came too late to take active part in Operation Torch (the code name for the Allied landings in North Africa in November 1942), the program was fully operational by early 1943.

In March 1943, COMINCH issued secret directives authorizing the recruitment of 180 officers and 300 enlisted men for the Beach Jumper project. The four basic requirements were: no seasickness, experience in small boat handling, sufficient electrical knowledge to fix a home radio, and fundamental familiarity with celestial navigation. Lest they thought they might be joining the Seabees, prospective applicants were assured that: "The Navy is requesting volunteers for prolonged, hazardous, distant duty for a secret project." Having survived the rigors of Notre Dame Midshipman's School, officer candidates were assumed to be fully physically qualified. First at Camp Bradford, Virginia and later at Ocracoke, North Carolina, trainees at Beach Jumper School were put through a strenuous course of seamanship, ordnance and gunnery, demolitions, pyrotechnics, meteorology, etc., not to mention advanced courses in radio and radar countermeasures and deception. Emphasis was likewise placed on explosives, detonators and fuses, smoke generators and shells, land mines, and firearms ranging from Colt 45-caliber automatic pistols to 40-millimeter anti-aircraft guns. On the technical side, one of the newly created devices, code named "heater," mounted in 63-foot converted Aircraft Rescue Boats (ARBs), could transmit the prerecorded sounds of amphibious landings down to the most minute details. The ruse was performed with the aid of heavy smoke screen, backed up by high explosive 4.5-inch beach barrage rockets to increase credibility, often right under the very noses of the enemy. This was but one of the many sophisticated inventions employed by the navy's "Dirty Tricks Department," not only to jam enemy radars but also to confuse and deceive hostile forces as to friendly intentions, capabilities, and actual operations, all of which were utilized most effectively and successfully by the amphibious forces initially in Mediterranean waters, later in the Pacific in the Philippines and Palau, and subsequently in Korea and South Vietnam.

In this carefully written and highly condensed account, the author has skillfully portrayed in painstaking

detail the complex history of the Beach Jumper Units (of which there were at least seven) from start to finish. In the 1970s they became Fleet Tactical Deception groups, Atlantic and Pacific, assisted by the navy's SEALS (sea-air-land commando teams). It is a very comprehensive history of a little-known group of adventurous young men, some of whom earned well-deserved decoration, a tale which for security reasons was highly classified. Citations are pertinent, maps and photographs are adequate, glossary and index are most complete. Of necessity the author was practically forced to employ about every known acronym in the navy's long list of Pentagonese jargon, which in spots makes reading somewhat difficult, but in no way detracts from the whole.

During the Korean Emergency in the early 1950s at Camp Pendleton, California, this reviewer conducted a formal inspection of the Reconnaissance Battalion, Third Marine Division, FMF. Having been deliberately composed of the most rugged volunteers in the entire command, the battalion, after a year's strenuous participation in numerous amphibious assault landing exercises at division level, was a very formidable unit. Asked at the close of the examination by its notably aggressive command as to my overall impression, my unhesitant reply was: "Major, I don't know what the North Koreans or the Chinese Communists think of you people, but you sure scare the hell out of me." Undoubtedly a similar reaction would be forthcoming by any party who encountered the navy's Beach Jumpers.

ROGER WILLOCK

Cumberland Foreside, Maine

REAR ADM. EUGENE B. FLUCKEY, USN (RET.), *Thunder Below! The USS* Barb *Revolutionizes Submarine Warfare in World War II* (Urbana and Chicago: University of Illinois Press, 1992). Cloth, 444 pages, 54 illustrations, appendices, index. $29.95.

This book adds another volume to the growing literature on the only successful submarine campaign ever waged, the U.S. offensive against Japan during the Second World War. The author, who commanded the USS *Barb* on her last five patrols from May 1944 until the end of the war, conducted extensive research to uncover and verify as many aspects of his patrols as possible. The result is a well rounded and readable account of one submarine's very aggressive war.

Eugene Fluckey was awarded the Congressional Medal of Honor for his actions in *Barb*, and this book makes the reasons evident. He was both a skillful and lucky warrior, and readers can draw their own conclusions as to which element was most important. Certainly both were necessary. His submarine destroyed, by his own detailed research, over twenty-nine Japanese ships. In one attack alone, an incredible night surface attack, his boat destroyed a carrier and a tanker with one spread of six torpedoes before diving at the last possible moment to avoid an approaching escort.

By far the best aspect of this book is the detailed research evident throughout. Admiral Fluckey consulted all possible sources during his writing. This included expected ones, such as the official logs and reports submitted by *Barb* at the end of her patrols, as well as his own letters and memories of these events. He also consulted many of his crew and others associated with the submarine during this period. This resulted in the discovery of a detailed diary kept, illegally, by one crewman. In addition to this, Fluckey cross-referenced his research with material from Japanese archives and through consultations with Japanese veterans. Finally, he traveled to remote coastal locations in the People's Republic of China to search for witnesses to another of his daring actions, a night surface attack on a convoy at anchor in a small port along China's coast.

The result is a book that stands comparison with any in this genre. Where appropriate the author has included extracts from Japanese archives to give a sense of what was happening "on the other side," as, for example, during the previously mentioned attack on the carrier and tanker. This adds a refreshing dimension to his account, making it a useful tool for historians as well as fascinating reading for anyone interested in naval actions.

The aggressive manner in which Fluckey employed the *Barb* exemplifies why the United States was successful in this submarine campaign. He used every scrap of intelligence, from prisoners of war to decrypted signals, to find and attack increasingly furtive Japanese shipping. While the submarine dived if enemy aircraft approached directly, she spent most of her time on the surface scouring the seas for more ships. *Barb* used every possible ruse when approaching to attack, including sneaking up from astern at night so as to appear to be part of the escort screen before launching an attack into the main body.

While none of these efforts could be described as reckless, they all demonstrate the very poor state of Japanese antisubmarine warfare. With the exception of the use of rockets to bombard coastal installations and his other depredations on Japanese shore facilities, *Barb*'s actions are remarkably similar to the efforts of the most aggressive German U-boat commanders in the first part of World War II, before Allied antisubmarine measures became more effective. In short, similar conditions resulted in similar solutions being developed by submariners so as to inflict the most damage on their oppo-

nent. That being said, it should also be noted that Fluckey and *Barb* were a devastatingly effective team.

The book is well written, but somewhat stilted from time to time. In a curious way, however, this is not really a distraction. Admiral Fluckey has evidently made an honest effort to recreate accurately how he and his crew lived in this period, both while aboard their boat and ashore. As a result, some of the conversations are, perhaps, sometimes a little tedious and uninspired, but this is often how real life in a small group can be. The flavor of the period comes through very well, however, making this a valuable source for insights into attitudes in the submarine force in 1944-45.

The illustrations are well chosen to show the career of the *Barb*. There are a number of dramatic shots through the periscope or from the deck during actions. There are also a number of less dramatic but interesting photographs, including such incongruous sights as the picture of a bird perched atop the attack periscope (taken from the search periscope) which complicated one of *Barb*'s approaches. The numerous photographs add considerably to the overall impact of the story.

In summary, this is a book worth reading for those interested in this area of naval history and equally suitable for those simply looking for a good yarn. Admiral Fluckey has done credit to his boat and his old shipmates with this thorough recounting of their exploits.

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FRANK DEBENHAM, *The Quiet Land: The Diaries of Frank Debenham, Member of the British Antarctic Expedition 1910-1913*, ed. June Debenham Back (Huntington, U.K.: Bluntisham Books; Norfolk, U.K.: Erskine Press, 1992). 207 pages, photographs, illustrations, maps, glossary, bibliography.

Frank Debenham began his long association with polar studies and exploration as a member of Robert Scott's second polar expedition of 1910. One of two Australians to accompany Captain Scott, Debenham, at the age of twenty-six, signed on as junior geologist on the scientific staff of eight. During 1911 and 1912, he conducted numerous surveys of the glaciers and land forms and collected specimens across an extensive area near McMurdo Sound. Meanwhile Scott, determined to beat a Norwegian expedition under Roald Amundsen to the Pole, set off further southward in 1911 in an effort which proved fatal to him and five companions. This book is the record of that expedition as seen by Debenham, drawn principally from his personal diaries as well as from some of his letters.

In an engaging prose style, Debenham describes several of his surveying and collecting forays, supplemented in the book by his own plane table sketches and maps. Of greater interest to the general reader will be his descriptions of the expedition's equipment and of daily life in camp or on marches, frequently embellished with quick sketches from Debenham's hand.

Debenham's diary does not approach the completeness nor polished style of Scott's own journal (*Scott's Last Expedition*, New York, 1913), which, as the official record of the expedition, is voluminous in its daily detail. It is a good complement to Scott, however, and to Edward Wilson's *Diary of the Terra Nova Expedition to the Antarctic 1910-1912* (London, 1972). As a junior member of the party and someone who brought fresh curiosity to the task, Debenham has left us with a fascinating microview of life in the Antarctic in an early twentieth-century research expedition.

Everything from the workings of the portable cooking stoves (ingenious) to the sledges (dependable), snow goggles (poorly designed), and other items of personal equipment engages his attention early on. Later, it is glacial patterns, valley structures, and animal behavior which he describes. During periods of reduced winter activity, he focuses on camp life and its effect on men and dogs. Finally, Debenham deals with the painful realization of the fatal outcome of Captain Scott's polar party, confirmed when the search party sent out in October 1912 finds their remains close to the cache of food and supplies.

The book is edited by Debenham's daughter, who has added photographs taken by Debenham (who served for a while as the expedition's photographer) and others, as well as a concluding chapter on "Deb"'s career as director of the Scott Polar Research Institute (1920-1946) and holder of the first chair in geography at Cambridge University. A glossary, a postscript on Debenham's work by D. W. H. Walton, and a bibliography of his publications round out the volume. In all, the editor has skillfully assembled and arranged an effective story in words and pictures.

Debenham wrote his diary for personal use, and it is that which gives it its informal charm and immediacy. However, it also means that many things are not explained fully or in context, and the reader is sometimes left puzzled by some passages. Here the editor could have done a service by providing an introduction to the background, purpose, and execution of the expedition, so that such terms as "Western Mtn. people" (p. 18) and "Eastern party" (p. 25) in the diary would have been meaningful. References to Shackleton's and Scott's earlier expeditions should have been explained also. Similarly, a map of the

larger area of Antarctica visited by the expedition of 1910, to supplement Debenham's smaller scale sketches, would have been helpful.

E. JEFFREY STANN

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WILL AND SHARON ROGERS, WITH GENE GREGSTON, *Storm Center: The USS* Vincennes *and Iran Air Flight 655* (Annapolis, MD: Naval Institute Press, 1992). 264 pages, illustrations, maps, index. $21.95.

Storm Center is "a personal account of tragedy and terrorism" written by Captain Will Rogers, the commander of the U.S. Navy's Aegis cruiser *Vincennes*, and his wife Sharon. While the book provides the reader with a brief background on the Rogers's lives before the summer of 1988, the body of the work focuses on the immediate events leading up to the shooting down of the Iran Air Airbus in July 1988, the incident itself, the subsequent investigation, and the bombing of the Rogers's Toyota minivan (occupied by Sharon Rogers) in March 1989. While the book is insightful and contains much useful information, Will Rogers fails to address many questions that linger years after the incident.

Without a doubt, the strongest section of the book is that leading up to the downing itself. Captain Rogers gives a good account of the chain of events that carried the *Vincennes* from San Diego to the Strait of Hormuz as part of an unplanned deployment. Ever since the incident, there have been stories afloat in the press that the *Vincennes* was less than fully prepared for the situation in which the ship found herself, reports of exercises and briefings designed to prepare ships for Persian Gulf tours that no one from the *Vincennes* attended. Rogers has consistently denied that his ship and crew were by any measure unprepared. It appears obvious in the book, however, that the decision to pull the cruiser out of a West Coast exercise and to send the *Vincennes* post-haste to the Persian Gulf left Rogers with little time to take advantage of the normal work-up programs designed to prepare ships for the peculiar circumstances they might confront in the Gulf. Thus the *Vincennes*, while fully capable by ordinary readiness standards, was denied the opportunities for preparation available to other ships headed to the Persian Gulf and was, by that measure, less than fully prepared, though through no fault of Captain Rogers or his crew. Unfortunately, only an informed reader would be able to deduce this from the book, since Rogers does not address the question directly.

Rogers's account of the 3 July downing, while informative, also dances around several issues. The captain does a good job of conveying the very real sense of expectation then rampant in the Gulf that the Iranians were up to something. Such anticipation of attack helped shape the mindset that led to the downing. But Rogers is somewhat less than perfectly clear about the details of some of the events of 3 July 1988. He, and the U.S. Navy, claimed that the *Vincennes* was outside Iranian territorial waters. But a video recorded on the bridge of the cruiser indicates that the ship at one point was within nine nautical miles of Iran's Queshm Island. Rogers, of course, had the right to maneuver as he saw fit during the course of the engagement with the Iranian gunboats. But why the steadfast denial? Did Rogers, who was not on the bridge but in the Combat Information Center during the engagement, lose track of his ship's position? Or was his silence in the book (he has subsequently acknowledged that he was across the line) just in keeping with the party line?

Rogers's account of the downing and subsequent investigation answers many but by no means all of the relevant questions. He and his crew had claimed initially that the Airbus had squawked the IFF (identify friend or foe) codes of an Iranian F-14, that the Airbus had flown directly at the *Vincennes*, and had been descending at the time Rogers ordered the two surface-to-air missiles fired. But the data tapes from the Aegis radar system indicated that the Airbus was climbing not descending. Since the equipment was in order, there must have been human error. But Rogers continues to reject that thesis and in the book points the finger at an unusual conjunction of events, identifying the Navy's NTDS (Naval Tactical Data System) Link 11 as the culprit. While this may explain the IFF problem, it does not address the question of why *Vincennes* crewmen believed the Airbus was descending. And, oddly, Rogers fails to mention that the Airbus was over twenty minutes behind schedule, an exculpatory factor that helps to explain why *Vincennes*'s crewmen, armed with a schedule of civilian flights, assumed the radar contact was hostile and not an airliner.

Nor does Rogers's account shed any light, or even address, questions raised this past summer (unfortunately after the book's publication) by an ABC/*Newsweek* investigative report that charged that the *Vincennes* was involved in a secret operation intended to lure Iranian gunboats into an ambush. Rogers subsequently called the charges fantasy and denied any foreknowledge of such an operation. It is entirely possible that if such an operation was underway, Rogers may not have known. This reviewer personally observed one such operation in the Gulf that summer and can attest that secrecy (compartmentalization) was frequently so extensive that other platforms in the area were unaware of what was taking place. That is not to say that the ABC report was accurate, simply that if it was, it is conceivable that Rogers would have been kept in the dark.

The Rogers's account of the impact of the tragedy on their personal lives is the most poignant part of the book. Will Rogers's promising naval career was effectively short-circuited. Sharon's teaching career also ended abruptly when, following the bombing of her minivan, school officials, concerned for student safety, basically fired the already victimized woman. But here again, Will Rogers skirts around a few issues. He mentions in passing that, during the investigation of the bombing, federal agents gave him a polygraph test and that he was considered a possible suspect. There were unsubstantiated rumors about at the time, the nature of which will not be repeated here, that apparently led the Naval Investigative Service (the people who gave us the *Iowa* investigation) to consider the possibility that Rogers had attempted to kill his own wife. Unfortunately, the captain fails to provide the reader with any hint as to why the NIS and the FBI considered him a suspect.

For these reasons, *Storm Center* is a disappointing book. While it is a touching and often informative account, there are too many loose ends. It is hard to believe that Rogers consciously chose to be less than forthcoming. In his testimony during the investigation, in his television appearances, and in personal correspondence, he has appeared to be frank and forthright. Perhaps the Rogers were ill-served by their co-author, sportswriter Gene Gregston, best known for a biography of golfer Ben Hogan!

MICHAEL A. PALMER

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HERVÉ COUTAU - BÉGARIE, *L'Evolution de la Pensée Navale*, 2 vols. (Paris: Fondation pour les Études de Défense Nationale, 1990).

This two-volume collection of essays on *L'Évolution de la Pensée Navale* is a welcome addition to the growing literature on naval thought and doctrine. Rather than presenting a narrowly focused study on one particular country or historical epoch, Hervé Coutau-Bégarie has assembled a wide-ranging survey of naval thought from classical antiquity to the late twentieth century.

Although there is, not surprisingly, a good deal of emphasis on the development of French naval and maritime thinking, the study is not by any means Eurocentric, including as it does examinations of American and Asian naval theorists. Individual contributions are not arranged in topical or chronological order but are, nevertheless, invariably of high quality. Each essay stands alone and makes a useful contribution to a more comprehensive understanding of naval thought through the ages.

For scholars not familiar with the full ramifications of French naval thought, the articles dealing with the seventeenth-century Jesuit Paul Hoste, the Napoleonic era naval officer Audibert Ramatuelle, and the twentieth-century thinker Admiral Darrieus are very revealing. They indicate that many leading French naval thinkers advanced concepts typically associated with British practice and Mahanian concepts of a "blue water" fleet that sought decisive engagement as its primary operational and strategic role.

Various authors are highly critical of the *Jeune École* and its excessive reliance upon technology's ability to alter fundamental principles of naval warfare. Moreover, several articles note a constant tension between schools of thought derived from technological developments and concepts based upon historical experience. The authors tend to side with the historical school. Technology, they argue, may indeed change the face of battle, but strategic realities remain constant.

Without fundamentally disagreeing with the authors' conclusions, it is perhaps worth noting that the *Jeune École* was responding at least in part to the bleak strategic situation faced by the Third Republic during the last decades of the nineteenth century. Isolated diplomatically, French military and naval planners had to deal with the prospect of a clash with the Triple Alliance and Great Britain. Consequently, France had to devote the bulk of its fiscal and human resources to the protection of its land frontiers. The navy, therefore, operated with relatively limited budgetary resources, and it was not completely illogical for officers to seek a technological edge to counterbalance their overall naval inferiority. Interestingly, the influence of the *Jeune École* began to fade as the Republic's strategic situation began to improve. Countervailing alliances with Russia and England as well as advances in ship design and armament created the environment which enabled the historical school to reassert itself.

Another striking element in many of the contributions is the sense of historical continuity. Authors recognize that concepts do not simply spring forth from a void in the absence of historical and intellectual precursors. The study of Athenian naval thought emphasizes that the view of the navy as the basis of the city's power and survival was the product of a long and complex evolution. Hellenistic naval thought expanded upon earlier experience and gradually developed concepts that were strikingly modern. Alexander, for example, intended to construct an ocean- going fleet capable of dominating the Indian Ocean. Mahan's intellectual development owed much to the works of Jomini, and the study of Tirpitz argues that he was by no means the first German to advocate the creation of a high seas fleet or enunciate the concept of an alliance value risk fleet.

The editor has provided detailed and useful introductions to each volume. He recognizes that there are major gaps in his coverage, including examinations of Korean and Japanese naval thought and studies of lesser known, but nevertheless important, naval theorists. He promises that future volumes will deal with these and other topics. There remains much to be done. The evolution of amphibious warfare doctrine, studies of joint and combined operations, and the navy's role in nuclear deterrence and dissuasion all deserve extended treatment. Scholars can look forward with confidence to additional volumes in what promises to be a distinguished series.

STEVEN ROSS

Naval War College

SHORTER NOTICES

EDWARD WAKE-WALKER, *Goldmedal Rescues*, with paintings by Tim Thompson (Newton Abbot, Devon: David and Charles, 1992, distributed by Trafalgar Square, North Pomfret, VT, 05053). 96 pages, $85.00.

A handsome, oversized (11½" x 12¾") production, this volume celebrates the 118 gold medals given out duting the 169 years of the National Lifeboat Institution of Great Britain. The individual accounts are indeed of devoted heroism, and they are amply illustrated by engravings, historic photographs, and twenty major paintings (reproduced in color) by Thompson, a noted marine artist. For those interested in the subject, this is an attractive and authoritative commemoration.

JOHN B. HATTENDORF, R.J.B. KNIGHT, A.W.H. PEARSALL, N.A.M. RODGER, AND GEOFFREY TILL, EDS., *British Naval Documents, 1204-1960* (Aldershot: Scolar Press for the Navy Records Society, 1993). xviii + 1196 pages. $109.95.

This volume celebrates the first centenary of the Navy Records Society and represents the work of many hands, including quite a few unlisted on the title page. Some 535 documents are divided into seven roughly equal chronological sections (1204-1485, 1485-1603, 1603-48, 1648-1714, 1714-1815, 1815-1900, 1900-60), each in turn subdivided into general administration, materiel and weapons, and personnel. Each of the seven sections has its own editor or editors who were given a relatively free hand in the selection process. The result is a massive volume intended, as the preface notes, "to serve as an introduction to British naval history for the beginner and as a basis for further inquiry by the more expert." A substantial glossary, list of sources, and bibliography, together with a detailed index, complement the collection.

The Shipbuilder's Repository, 1788 (Rotherfield, East Sussex: Jean Boudriot Publications, 1992). 472 pages, £85.00.

Originally published in 1788 in a printing of no more than two hundred copies, *The Shipbuilder's Repository* has now been reproduced in a limited facsimile edition (750 numbered copies) by Jean Boudriot Publications. In essence the anonymous work is a compilation of all the principal dimensions and scantlings for every type of vessel in the Royal Navy in the late 1780s, and as such was an essential reference work in its day. To the original text has been added only the draughts of thirteen vessels which were not included in the first edition. For those interested in the details of late eighteenth-century shipbuilding, this is a valuable volume, difficult or impossible to find in the first edition.

ERIN URBAN, *Hulls and Hulks in the Tide of Time: The Life and Work of John A. Noble* (New York: John Noble and Allan A. Noble in association with the John A. Noble Collection, 1993). 269 pages, index. $75.00 (available from the publisher, 1000 Richmond Terrace, Staten Island, NY, 10301).

The John A. Noble Collection is a maritime museum and study center located in the Snug Harbor Cultural Center (a former home for retired seamen) on Staten Island. Noble (1913-1983) was a prolific artist whose work incorporated a lifetime of careful observation of the maritime life of New York harbor. In this book — her second on Noble — Erin Urban presents a collection of seventy-nine Noble lithographs, supplemented by a substantial introduction together with detailed notes on each illustration. A well-presented, oversized (9½" x 12") book, this volume belongs in any collection on maritime art or the history of New York's waterfront.

BRITON C. BUSCH

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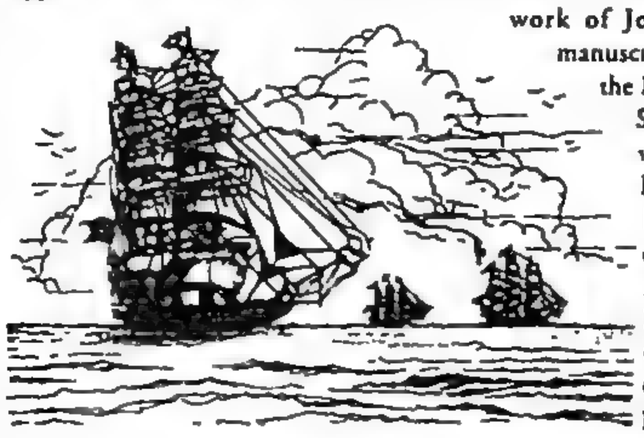

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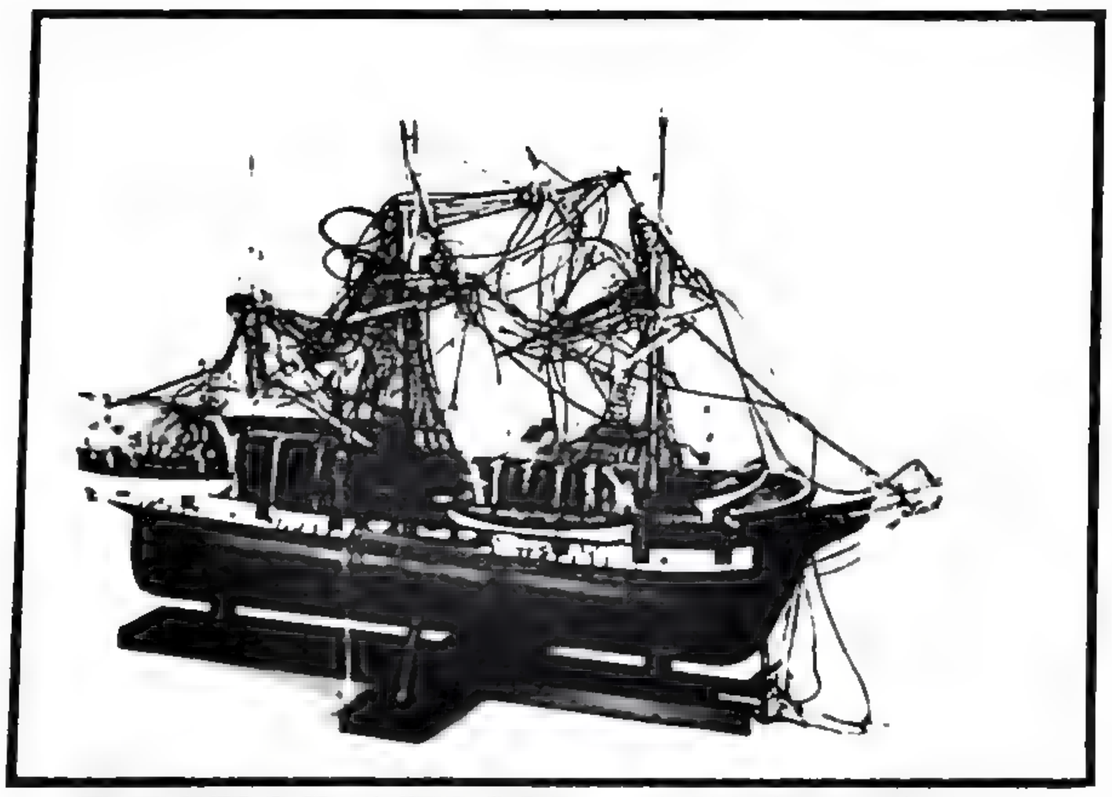

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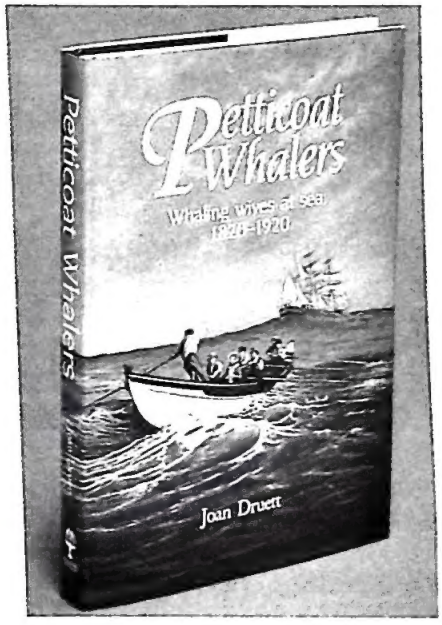

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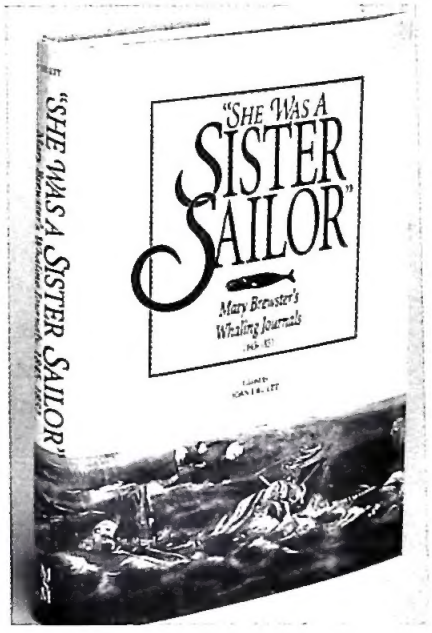

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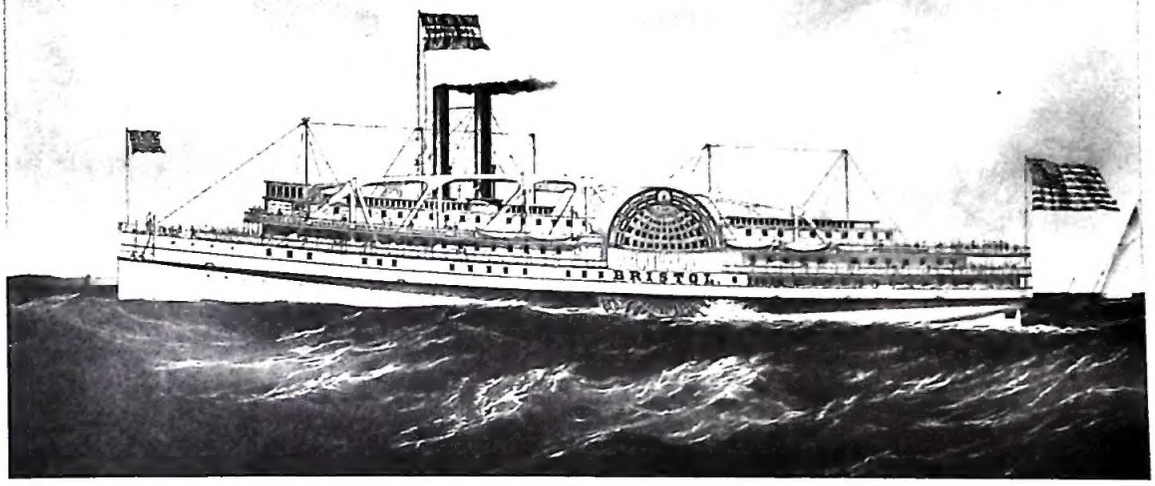

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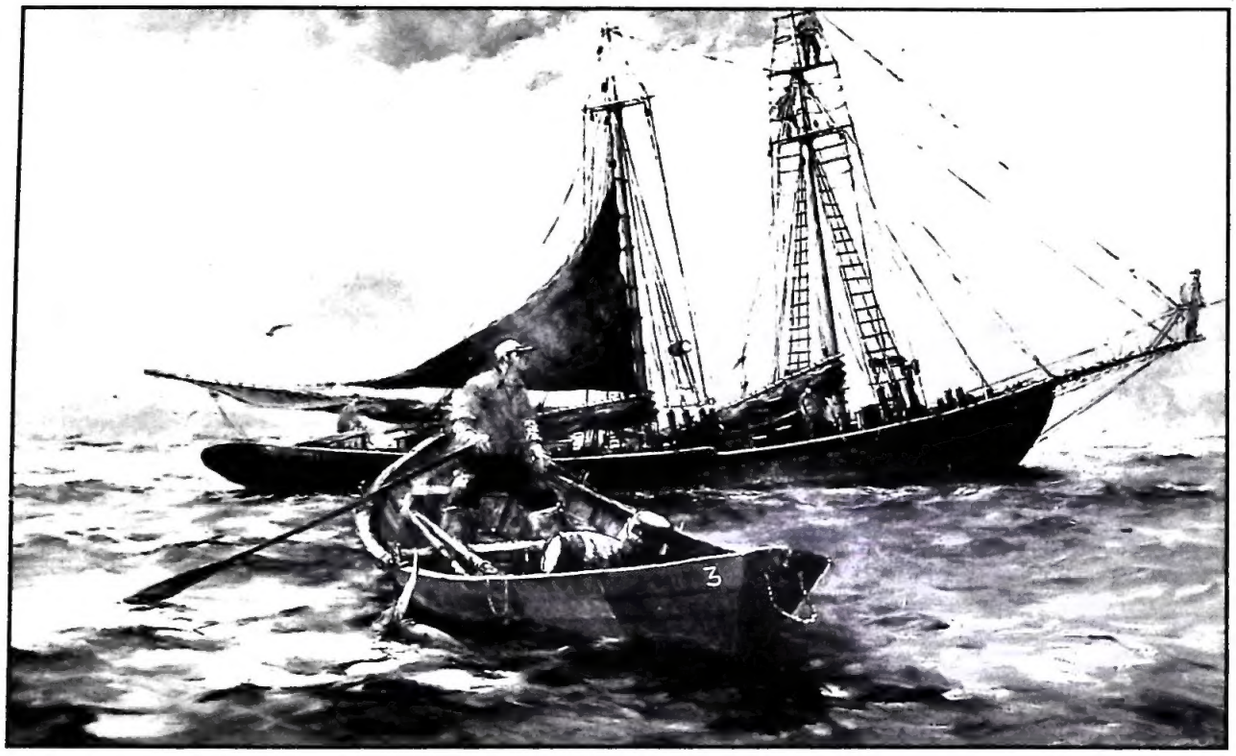

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